HYBRID AUDIO TECHNOLOGIES

Stage VI

Legatia SE

Legatia SE-Series Component Speakers

Specifications Library & Car Audio Reference Guide

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Welcome and Introduction

Congratulations on your purchase of high performance Legatia SE-series mobile audio component loudspeakers, and welcome to the world of Hybrid Audio Technologies, where high-end mobile audio loudspeaker development is our passion! When installed and set-up properly, the Legatia SE component system you have purchased will be the finest loudspeakers you have ever heard and give years of superior performance.

Thank you for going “on line” to read and download your User’s Manual. Our offices are located amongst the evergreens in North Georgia USA, and we happen to like trees. Aside from the obvious aesthetic benefits, trees improve our air, protect our water, save energy, and improve economic sustainability. Additionally, it is expensive to print and distribute thousands of copies of an owner’s manual; we’d rather invest our production dollars into an incredible line-up of speaker systems for your listening pleasure. With online resources becoming the main source of information for more and more people, we are pleased that you’re here, reading this manual on line, verses having a print copy which might get read once and put back into the gift box, or worse yet, discarded.

With the publication of this specifications library and car audio reference guide, it is our goal to assist the “do it yourself” enthusiast and professional installer alike in getting the highest level of performance out of Legatia SE component speakers and sets using straight-forward installation advice and practical application of timeless acoustic principles. The first part of this manual is comprised of a specifications library for all of our available Legatia SE component speakers, passive crossover devices, and available accessory hardware. Simply scroll through the library to learn more about the wide variety of Legatia SE products. The second part of the manual has been written to be more or less a miniature mobile audio reference guide that can be used to better any sound system, and in particular, a system that utilizes the Legatia SE component speaker systems. It is an introductory primer to the world of high-end mobile audio; we hope this user’s manual is not only informative, but motivating. Keep it handy throughout your installation process, and any time you go to improve your audio system with other Hybrid Audio Technologies products, or perhaps to take advantage of our lifetime guaranteed value trade-in program. We are confident that if the principles explained in this manual are exercised in your own installation, you will be ecstatic with the sound quality outcome!

We realize that you have a choice in loudspeakers, and are thrilled that you have chosen the Legatia SE series. For more information about Hybrid Audio Technologies, our philosophies regarding high-end mobile audio, to learn more about our lifetime guaranteed value program, and for information about our other products, please visit us online at www.hybrid-audio.com.

Thank you, and happy listening!

Scott E. Buwalda
Founder – Hybrid Audio Technologies

Legatia SE Speaker Design Considerations

The Legatia SE-series component speakers are electrodynamic drivers that are comprised of a diaphragm (cone, or in the case of the Legatia SE L1 Pro R2, a fine fabric diaphragm and ring) that is set in motion by a motor system that has both electrical and mechanical components. For more details about the Stage VI Legatia SE tweeter offering, the Legatia SE L1 Pro R2, please go to pages 11 and 16, respectively.

The Special Edition midrange and midbass designs boast several key elements which enhance the driver's performance between the Stage V Legatia-series speakers and the Stage VI Legatia SE-series speakers:

- Wider bandwidth operation;
- Notably lower inductance;
- Higher thermal power handling by AES standard;
- Higher thermal power handling with suggested crossover;
- Typically lower moving mass for better transient response;
- Typically higher compliance of motor system;
- Use of woven dual tinsel lead spider for mechanical balance, improved radial compliance, and to eliminate tinsel lead slap;
- Inclusion of nickel-plated, spring-loaded binding post terminals for enhanced connectivity;
- Inclusion of high-energy opposing double-stacked neodymium cup and motor for increased motor performance and smaller diameter motor;
- Inclusion of aluminum radiator for heat dissipation and increased thermal power handling;
- Inclusion of rose-tinted copper-plated aluminum extended phase plug pole piece; and
- Inclusion of laser-etched back plate cap with Hybrid Audio Technologies logo and Special Edition nomenclature.

The following design tenets are typical of all Legatia SE-series midrange and midbass drivers:

Motor

The motor of the Legatia SE midrange and midbass drivers are paramount to the performance of the drivers, providing for a flat and wide BL curve. The BL curve is flat and extended in all models, yielding exceptional two-way linear excursion, resulting in the Legatia SE midrange and midbass drivers being able to accurately track the input signal. Reduced distortion and greater dynamics are the immediate sonic benefits. The motor of the L3SE, L4SE, L6SE, and L8SE includes an opposing double-stacked high-grade NdFeB magnet assembly to improve restorative force, compliance, motor strength, displacement, and power handling, but also to serve a small diameter form-factor. The voice coil fully surrounds the opposing double-stacked magnet.

Voice Coil

The voice coil diameter of the Legatia SE range of midrange and midbass drivers represents *the optimal balance* of diameter, power handling, and moving mass. The L3SE and L4SE use a 25.5mm (1-inch) voice coil, and the L6SE and L8SE use 35.5mm (1.4-inch) voice coils. The voice coil diameter serves several key functions: elevated power handling, dissipation of heat (thereby lowering power compression), and maximizing the size of the magnet assembly for enhanced motor

compliance. The voice coils used in all Legatia SE designs are high-purity aluminum, which is superior to copper for heat dissipation, as well as significantly reduced moving mass. The result is an extremely light weight winding with good power handling and low inductance.

How much amplitude a speaker can reproduce depends on the volume of air it excites without overheating. The volume of air that a speaker excites is determined by the surface area of the cone and the excursion capability of the motor system. Xmax is defined as the width of the voice coil that extends beyond the front plate, and relates to how far the speaker can move in either direction without appreciable distortion. The Legatia SE designs boast exceptional one-way linear excursion (Xmax).

Phase Plug and Shorting Cup

All Legatia SE midrange and midbass drivers come equipped with a phase plug pole piece extension at the center of the cone. The phase plug is aluminum and, by design, ensures enhancement of the total inductance profile, providing much of the inductance reduction benefits noted. The phase plug is plated with rose-tinted copper, which by design does not negatively reduce eddy current, and adds thermal dissipation potential. The phase plug extends well down inside the pole vent, and acts as a very large and efficient heatsink for any heat that radiates into the pole. The highest frequencies of audio emanate from the area around the center of the cone and the lower frequencies are produced by the area of the cone that is farther from the center. The phase plug pole piece extension improves the performance and clarity of all Legatia SE midrange and midbass designs by deflecting delicate midrange and treble tones forward of the driver, while minimizing distortion and improving bandwidth.

All Legatia SE midrange and midbass drivers use copper shorting cups. The shorting cups consist of an optimally sized and placed cup of copper (Cu) to create a total inductance profile that is not just low, but flat over stroke, frequency, and power. Inductance is the number one limiter of high frequency extension and modulation of inductance with stroke, frequency and power, and is the primary source of intermodulation distortion (IMD).

Cone

The shape, weight and strength of the Legatia SE midrange and midbass cones relate directly to the extended frequency response of the Legatia SE range of drivers (in concert with the extended phase plug pole piece, noted above). The Legatia SE cones are concave-shaped hybrid paper diaphragms, described below. Convex shaped cones, typical of “dome” midranges, typically exhibit “peaky” frequency response, so we opted instead on a concave cone topology for the resultant smoother frequency response. And contrary to common belief, most convex cones have a narrow directivity pattern. The concave cone of the Legatia SE midrange and midbass drivers have a wider directivity pattern, and are excellent for use in “off-axis” applications.

You will find no composite or metal cone materials used in any Legatia SE midrange or midbass driver. Our approach to point-sourcing is to allow the Legatia SE midbass/midrange drivers to effectively play into treble frequencies; having virtually all imaging cues emanating from one set of drivers in an installation ensures stable stereo imaging across the fundamental frequencies which define image placement and definition. The Legatia SE midrange and midbass drivers include a proprietary hybrid paper diaphragm with extremely low moving mass. Paper is widely acknowledged as the best-damping material, as it provides the near optimum balance of strength and weight. The paper cone is critical to tame unwanted cone modes, resonances, and the classic “cone breakup”

associated with most composite cones, but still be rigid enough for upper midbass response. All cones have been treated with a water resistant element at the rear to accommodate door mounting, or other areas prone to occasional contact with liquid.

All Legatia SE designs offer an outstanding extended frequency response; the usable frequency range of the Legatia SE midrange and midbass drivers is at least six full octaves, and in many cases, seven or more octaves of usable bandwidth with proper installation, aiming, set-up, and tuning. And because of the employed cone technology which boasts exceptional off-axis response, described above, all Legatia SE drivers offer exceptional off-axis bandwidth as well, exceeding five octaves for all designs.

Suspension

All Legatia SE midrange and midbass drivers include an inverted surround made of butyl rubber which is highly consistent, and does not suffer the variance of natural rubbers. This rubber surround terminates mechanical vibrations well, having a low stiffness for positive damping of resonances. The surround, which acts as an air seal between the cone and the basket, adds to the restoring force of the spider. Another function of the surround is to absorb cone flexure waves as they are transferred up the cone. You'll also know a Legatia SE midrange and midbass design by its inverted surround; this design feature allows for the use of a smaller height grille, and more flexibility in mounting options. The inverted surround is also instrumental for taming edge mode distortion.

The spider material was chosen for optimal performance in all models; the spider is a 90/10 cotton/Nomex blend with single-dip low viscosity phenolic. This material provides the stiffness desired without being overly brittle or stiff, where vibrations in the spider are well damped and do not translate into the former or the cone.

Basket

The basket of the Stage VI Legatia SE series drivers are a shared design with the same size/diameter drivers in the Stage V Legatia series, for easy upgrade potential; the frames of similarly-sized drivers are interchangeable in mounting topology. The basket is a high-quality cast aluminum design, and contains a large flange providing for the mounting of the driver via four screw holes. The Legatia SE frame features large openings behind the cone to eliminate chuffing and other aerodynamic-based noises, as well as provides adequate communication to the back of the cone for acoustic suspension and proper operation.

Thiele/Small Parameters Introduction

Acoustics pioneers Neville Thiele and Richard Small developed a way to predict speaker performance and frequency response. These parameters are known collectively as “Thiele/Small Parameters”, and are divided into physical characteristics and response parameters:

The Physical Characteristics of a speaker are:

Re: The D.C. resistance of the voice coil measured in Ohms.
Sd: The surface area of the speaker’s cone.
BL: The magnetic strength of the motor structure.

Mms: The total moving mass of the speaker including the small amount of air in front of and behind the cone.
Cms: The stiffness of the driver's suspension.
Rms: The losses due to the suspension.

The Thiele/Small Response parameters are:

Re: The D.C. resistance of the voice coil measured in Ohms.
Sd: The surface area of the speaker.
Fs: The resonant frequency of the speaker.
Qes: The electrical "Q" of the speaker.
Qms: The mechanical "Q" of the speaker.
Qts: The total "Q" of the speaker.
Vas: The volume of air having the same acoustic compliance as the speaker's suspension.

Application to Thiele/Small Parameters to Legatia SE Designs

Enclosure Recommendations

The mechanical and electrical parameters of the Legatia SE midrange and midbass drivers are amenable to a variety of different installations and speaker locations. In a typical vehicular installation, Hybrid Audio Technologies recommends that the Legatia SE drivers be placed in an "infinitely large" enclosure, which is more notably known as "infinite baffle." Small sealed enclosures are not needed to be constructed, nor are typically recommended in most circumstances for any of the Legatia SE range of products (there are some minor exceptions, based upon application, intended use, power handling, and etc., please contact us for details). Hybrid Audio has also had great success incorporating the Legatia SE midrange and midbass drivers in dipole configuration (detailed below), transmission lines, and in larger vented enclosures.

In a typical installation, Legatia SE midrange and midbass products should be mounted with unrestricted access to airspace to ensure the speaker's ability to effectively reproduce its wide frequency bandwidth. The reason why the speaker was designed in this way is highly empirical. When a speaker is mounted in a small closed box, it radiates as much energy forward of the cone as it does rearward of the cone. All speaker cones and dust caps (diaphragms) are a weak sound barrier at best, and the result of the high amount of energy being "pushed" into a small enclosure is the energy transmitting through to the outside of the cone (an additive phenomenon to the incidental wave). It is conjectured that this effect is most notable in the low hundreds of Hz region, where acoustical stuffing materials are ineffective and the internal dimensions are not small enough for the internal air volume to act as a pure compliance. Consequently, Hybrid Audio has designed this speaker to work well without an enclosure, and as such, should not be significantly prone to enclosure back-pressure and sound coloration when placed infinitely baffled. The "infinitely large" enclosure, per se, improves spectral response and power response variation between high and low frequencies. And in the case where an infinite baffle operation is difficult or impossible to achieve in your car's environment, we highly suggest the use of acoustic resistors (aperiodic membranes or trade name Variovents®) in sealed enclosures to help dissipate the backwave energy. If you absolutely must use a sealed enclosure, we recommend that you contact us for details and assistance in targeting a sealed enclosure volume applicable for your intended purpose. In all cases, the use of loosely-packed fibrous damping materials, such as fiberglass, Dacron, or long-fiber wool

will also significantly improve the final installation, no matter what type of baffle and enclosure configuration is chosen.

Dipole Applications

While infinite baffle or resistive sealed enclosures are highly recommended for this driver, you might find that in the rare instance that the Legatia SE drivers can be placed in a completely open baffle, i.e. dipole. A word of caution: Legatia SE drivers mounted in an open baffle have to move more air than a similar Legatia SE driver mounted in a resistive sealed enclosure, or infinitely baffled, just simply for the fact that there's a progressive acoustic short circuit between front and back waves below the speaker's resonance frequency (Fs) in the open baffle configuration. Great care must be taken in this instance, because there is no acoustic compliance afforded in a dipole configuration, and the speaker will reach its mechanical limits much quicker (and will net increased distortion). However, in certain instances, a dipole-style midrange may work well in a vehicular installation, in that radiation from the rear of the baffle, having undergone enough phase shift as it comes around to the front, adds to the total sound at off-axis angles. Of great importance in the dipole midrange configuration is the setting up of crossovers and weighing the negative effects of distortion of elevated amplitude levels.

Legatia SE L1 Ring Radiator (R2) Tweeter

History

The Legatia SE L1 R2's topology is an enhanced "ring radiator" version of the successful low-resonance Legatia SE L1 Pro. The purpose of the L1 R2 topology was to build upon the success and efficacy of the Stage VI Legatia SE L1 Pro, but the offer the driver in a radiator ring topology to further enhance on-axis and off-axis frequency response, increased bandwidth, and lower modal distortion. The Legatia SE L1 R2 is the culmination of an inordinate amount of time and resources spent testing and refining this product to the exacting specifications of Hybrid Audio Technologies and our long heritage of quality speakers. We are certain that this product will provide class-leading performance - that simply cannot be beat by competing brands – if installed properly.

The Legatia SE L1 R2 is a direct descendant of the massively successful, limited edition Stage VI Legatia L1 Pro Special Edition (SE) tweeter that was released on November 24, 2009 (please reference the Hybrid Audio Technologies website for more details on the Legatia L1 Pro SE). The L1 Pro SE was built in extremely limited production and was an evaluative line by Hybrid Audio Technologies to gauge consumer interest in a super high-end ring radiator design from the company. The SE tweeters were completely sold out by March 1, 2010. Given the efficacy of the design and its popularity as the "tweeter of choice" for high-end car audiophiles around the world, the team at Hybrid Audio Technologies began refining the SE tweeter design in early 2010. Several minor enhancements were realized to the tweeter's hard parts during the design process, with the ultimate goal of producing a driver becoming of the original SE design, but in a permanent, non-limited edition offering within the Hybrid Audio Technologies line-up.

By late January 2010, beta prototypes had been disseminated amongst Hybrid Audio's elite group of world championship car audio competitors, as well as other independent speaker testers, and the verdict was clear – the Legatia L1 R2 was ready for production. Production refinements included the Spring and early Summer of 2010, to include features inclusive and proprietary to the L1 R2, and final production commenced late Summer 2010.

Notably, approximately eight months after launch, using the L1 R2's as tweeter drivers in his own sound quality competition car, Scott Buwalda set the highest recorded score of all time in organized sound quality competition (996 points) at the International Auto Sound Challenge Association (IASCA®) North American Championships on March 19-20, 2011. This achievement has been memorialized by IASCA® in writing as the highest score on record, and it has been noted by IASCA® that the score achieved will likely remain the highest combined sound quality and installation quality score of all time, in any format, in any part of the world.

The Legatia L1 R2 is the world's finest ring radiator tweeter – bar none. No competing manufacturer can match the performance of the Legatia SE L1 R2. It is the world's first and only ring radiator design that boasts incredible off-axis response, for extreme mounting flexibility in the car environ. The L1 R2 tweeter is an exceptional super high-end solution for installers, enthusiasts, and car audio competitors, and provides the tweeter foundation for many of our high-end two-way and three-way systems.

Attributes

The Legatia SE L1 o R2 is a 58mm (2.3-inch) O.D. “low resonance” wide-bandwidth tweeter driver to compliment both two-way and three-way system designs, where a super high-end tweeter driver is required. The Legatia L1 R2 is based upon the original architecture of the Hybrid Audio Technologies Legatia L1 Pro transducer, as well as the Legatia L1 Pro SE, a special edition version of the L1 Pro. At the onset of the Legatia Pro-Series program, we wanted to be sure that the Pro-Series tweeter could be listened to for long listening sessions with no noticeable listener fatigue, and the L1 R2 answered the call. The L1 R2 is an advancement of the original Legatia L1 Pro design, boasting a ring radiator and diaphragm for exceptional polar response and an even broader frequency response, and lower resonance frequency than the original L1 Pro.

The Legatia L1 R2 is a 25mm (1-inch) ring radiator-type tweeter, which is the desired diameter for aplomb performance and class-leading polar response, having an extended linear response and exceptional transient response. The design offers a wide dispersion pattern to make for flexible on- and off-axis installation and speaker location. The L1 R2 doesn’t suffer from typical “heaviness” in tonal quality, typically associated with damped, large-diameter (28mm +) dome tweeters; the L1 R2 can be used for the reproduction of upper midrange and treble frequencies in dedicated multi-way front-stage systems. The following are the L1 R2’s design attributes:

Diaphragm, Power Handling, and Wave Guide

With respect to the diaphragm, the L1 R2 has a slightly heavier moving mass than the L1 Pro (without negatively affecting transient response), which in turn has afforded more damping character, while the resonance has been lowered by 120 Hz over the L1 Pro (580 Hz). Nominal and thermal power handling has also been improved over the original L1 Pro transducer; the L1 R2 tweeter has a very high power handling with proper filtering, and the L1 R2 diaphragm is much less susceptible to mechanical deformation than other designs, and yet yields a smooth response over the extent of its range. The diaphragm is protected by a large open-space perforated metal grille that can be removed, if desired.

The L1 R2 has several unique features that ensure performance is superior to all other designs in this category. The ring radiator geometry is notorious for delivering a flat, extended response, but many radiator designs have suffered historically from poor off-axis response. The main L1 R2 criteria was to have a ring radiator that could work exceptionally well in a car environment, with an end-user’s choice of either on- or off-axis operation with good polar response. The geometry of the wave guide was paramount to achieving this result and was the subject of a concerted effort by Hybrid Audio Technologies engineers. The wave guide is proprietary to Hybrid Audio Technologies and prevents phase cancellation for uniform frequency response and uniform polar radiation. The addition of the wave guide is also an improvement over a conventional dome tweeter design simply for the fact that the diaphragm is terminated not only at its edges, but also at the center of the diaphragm as well. This feature improves the damping of modal distortion and resonance. In concert with the wave guide is a treated fine cloth diaphragm to ensure smooth frequency response.

Tuned Chamber and Motor

The tuned chamber of the L1 R2 is the key to the ability of the driver to faithfully reproduce low-octave tones with low distortion, should the end-user desire this type of topology. The L1 R2 has a polypropylene tuned and damped chamber at the rear of the motor assembly; the chamber helps to

reduce backwave distortion and significantly lower the tweeter's resonance frequency to allow it to be used to play tones in the vocal spectrum. The tuned chamber is a proprietary design to Hybrid Audio; reduced distortion, low-octave authority, and greater dynamics are the immediate sonic benefits. The tuned chamber includes integrated push terminals, discussed later.

The motor assembly is conventional dynamic, with a high-grade Φ24.5 × 3.5 H NdFeB neodymium magnet structure to ensure a small footprint size and shallow depth. The result is the total profile of the motor as small as possible, enhancing acoustic performance, and aiding in mounting via small size and low weight. The L1 R2 is one of the shallowest tuned chamber tweeters on the market.

Body/Flange

The body and flange of the Legatia L1 R2 is one-piece machined 6061 aircraft-grade aluminum (not poured or cast aluminum). The dense metal structure, lacking interstitial voids, helps reduce vibrations within the body of the tweeter to abate resonance, and ensure effective reproduction of extremely low music tones. The R2 is a shared dimensional design with the Stage VI Legatia Pro and the Stage VI Legatia Pro SE for easy upgrade potential. If you already own the L1 Pro or L1 Pro SE, the L1 Pro R2 will drop right into place.

A machined aluminum Φ47.5mm knurled attachment nut at the base of the tweeter provides optimized clamping strength to the mounting media.

The mounting flange, only 3mm larger than the Stage V Legatia L1V2 tweeter, provides a solid-aluminum mounting surface for the tweeter without the necessity of mounting cups or external hardware. The overall dimensions of the driver are very amenable for use in the car audio environment, and in locations typical of the standard OEM tweeter mounting locations, as well as in custom locations, boasting a depth of just 27.5mm (1.08-inch), 2.5mm shallower than the sibling L1 Pro tweeter offering.

The L1 R2 tweeter is available in two colors to ensure cosmetic integration with the vehicle's surroundings: silver brushed aluminum, and anodized black (there is no cost difference between the two colors) with rose-tinted copper phase plug and radiator ring.

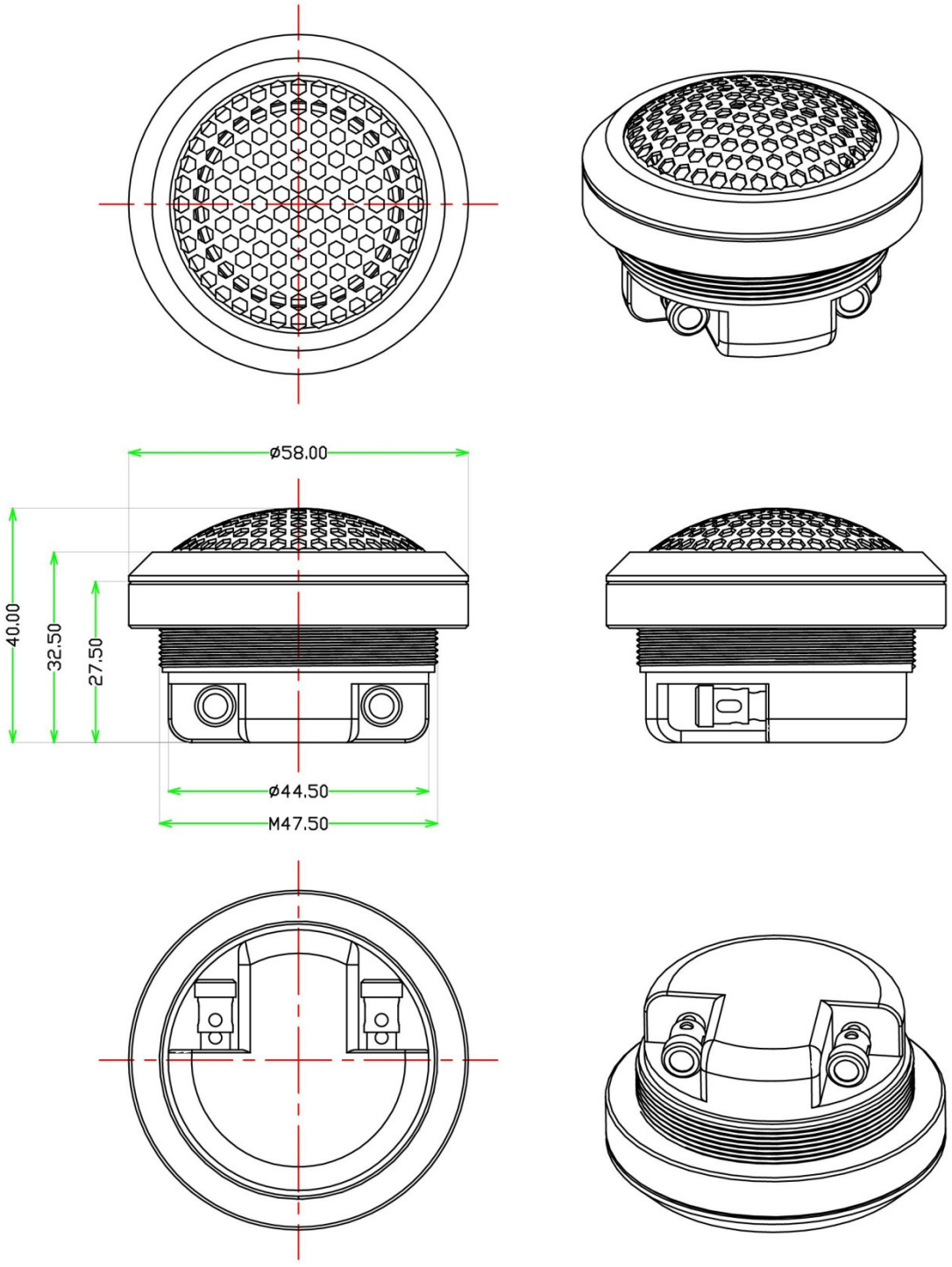
Terminals Cap and Spring-Loaded Terminals

The L1 R2 includes an extruded polypropylene tuned chamber with integrated high-end nickel-plated spring-loaded push terminals at the rear of the tweeter's motor assembly. The spring-loaded terminals give the end-user flexibility in direct connection with large-gauge tinned wiring, without the need for crimp terminals.

Summary

The Legatia L1 R2 is the ideal multi-purpose super high-end speaker driver. The size of the device and its incredible off-axis ability are amenable to a variety of different installations and speaker locations. The size of the L1 R2 allows it to be mounted in typical OEM and custom locations within a vehicle. At home in virtually any arrangement, the L1 R2 is Hybrid Audio's best tweeter, boasting exceptional performance and a design philosophy that goes hand in hand with true high-fidelity playback.

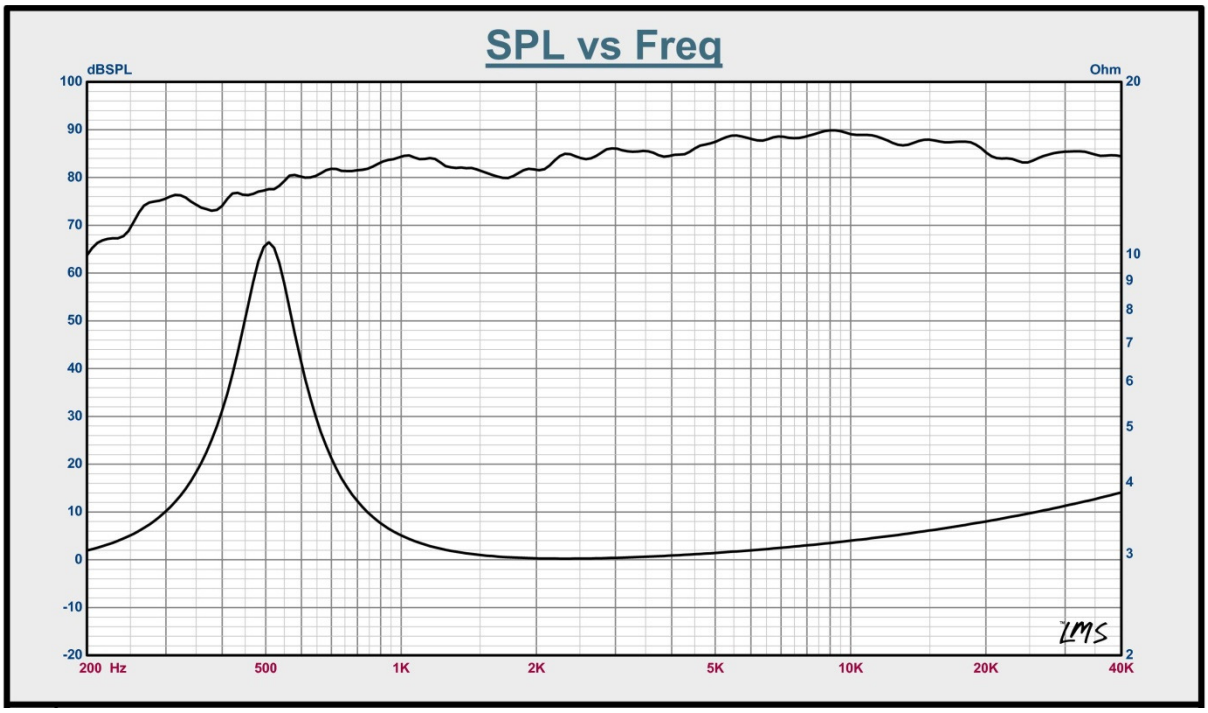
Mechanical Drawing



Thiele/Small Parameters

Overall Diameter	Φ58 mm
Mounting Depth	28.5 mm
Mounting Methodology	Surface-mount tweeter with standard-pitch M47.5 X 8mm thick knurled thread aluminum adapter to secure the tweeter body from the rear
Construction	Solid machined aluminum with integrated polypropylene rear cap and push terminals
Distortion	<5% max at rated power input, no crossover
Magnet Diameter and Construction	Φ24.5 × 3 H NdFeB
Recommended *Minimum* Crossover Frequency	2,000 Hz at 24 dB/octave highpass
P_{nom} Rated Power Input (No Crossover)	25 watts (AES Standard)
P_{max} Rated Power Input (No Crossover)	50 watts (AES Standard)
P_{max} (With Recommended Minimum Crossover)	120 watts
Resonance Frequency (Fs)	550 Hz
Frequency Range	550 Hz – 40,000 Hz, +/- 3 dB
Sensitivity	92 dB at 2.83V/1meter
Impedance	4Ω
DC Resistance	3.0 Ω
Voice Coil Diameter	25.5 mm (1-inch)
Qms	3.257
Qes	1.277
Qts	0.917
Krm	102.89 nΩ
Erm	0.733
Kxm	6.698 mH
Exm	0.377

Frequency Response Graph



Legatia L3SE Wide-Bandwidth Midrange/Full-Range

History

The Legatia L3SE's topology is an enhancement of the massively successful first-generation Legatia L3 transducer, as well as the revised "version 2" Legatia L3V2 which was launched in October 2011.

By early Spring 2010, a beta prototype pair of Legatia L3SE's had been refined after hundreds of hours of testing and development; these highly-evolved drivers were sent to various national- and world-championship competitors, notably including David Edwards, multiple MECA champion, and Jorge Juaristi, multiple USACi Mexico champion, for real-world evaluation. After countless hours testing on the speakers under various circumstances, both as a dedicated midrange and as a wide-bandwidth full-range driver, final approval was given. Production refinements were mid-Summer of 2010, to incorporate features inclusive and proprietary to the Legatia SE line, and final production commenced August 2010. The Legatia L3SE was launched in September 2010 and is the reference 3.7-inch driver in Hybrid Audio's product category known collectively as the Legatia SE Series.

Attributes

The Legatia L3SE is a 93mm (3.7-inch) "small format" wide-bandwidth midrange/full-range driver to compliment both two-way and three-way system designs, where a point-source midrange and/or full-range driver is required. The following are the L3SE's design attributes:

Basket

The basket of the L3SE is a shared design with the Legatia L3V2 and the original Legatia L3 for easy upgrade potential; the L3, L3V2, and L3SE are interchangeable in mounting topology. The basket is a high-quality cast aluminum design, and contains a 93mm flange providing for the mounting of the driver via four screw holes (the use of 3mm cap head screws is ideal). The overall dimensions of the driver are very amenable for use in the car audio environment, and in locations typical of the standard "3-inch" driver, or in custom locations at the discretion of the end-user, boasting a depth of just 44mm (1.7-inch), 1mm deeper than its Legatia L3V2 counterpart. The basket features large openings behind the cone to eliminate chuffing and other aerodynamic-based noises, as well as provides adequate communication to the back of the cone for acoustic suspension and proper operation.

Motor

The motor of the L3SE is paramount to the performance of the driver, providing for a flat and wide BL curve (as a learning note, BL is the equivalent of torque in a car; a car with a flat and constant torque curve provides much better acceleration and performance than a car with a peaky, non-constant torque curve). The BL curve is flat and extended, yielding 6mm of two-way linear excursion, resulting in the L3SE being able to accurately track the input signal. Reduced distortion and greater dynamics are the immediate sonic benefits. The motor of the L3SE includes an opposing double-stacked NdFeB magnet to improve restorative force, compliance, motor strength, displacement, and power handling. The magnet assemblies are fully surrounded by the voice coil.

Voice Coil

The voice coil diameter of the L3SE is a large 25.5mm (1-inch), which *is* the proper balance between size and moving mass in super high-end mobile audio midranges/full-range drivers. The voice coil diameter serves several key functions: elevated power handling, dissipation of heat (thereby lowering power compression), and maximizing the size of the magnet assembly for enhanced motor compliance. The voice coil is high-purity aluminum, which is superior to copper for heat dissipation, as well as significantly reduced moving mass. The result is an extremely light weight winding with good power handling and low inductance.

Suspension

The inverted surround is butyl rubber which is highly consistent, and does not suffer the variance of natural rubbers. This rubber surround terminates mechanical vibrations well, having a low stiffness for positive damping of resonances. The spider material was chosen for optimal performance; the spider is a 90/10 cotton/Nomex blend with single-dip low viscosity phenolic. This material provides the stiffness desired without being overly brittle or stiff, where vibrations in the spider are well damped and do not translate into the former or the cone.

Cone

Like other Legatia SE midrange designs, you will find no composite or metal cone materials used on the L3SE, as our approach to point-sourcing is to allow the Legatia SE midbass/midrange driver to effectively play into upper treble frequencies. The Legatia L3SE is a cone-type driver consisting of a proprietary hybrid paper diaphragm with extremely low moving mass. Paper is widely acknowledged as the best-damping material, as it provides the near optimum balance of strength and weight. The cone has been treated with a water resistant element at the rear to accommodate door mounting, or other areas prone to *occasional* contact with liquid. The cone design offers a wide dispersion pattern to make for flexible installation and speaker location. The Legatia L3SE has an outstanding extended frequency response; the usable frequency range of this driver exceeds seven complete octaves of usable bandwidth on-axis (140 Hz – 18,000+ Hz). Even off-axis, the L3SE faithfully recreates more than five full octaves of information, for the ultimate “small-format” midrange/full-range driver.

Phase Plug and Shorting Cup

The L3SE comes equipped with a phase plug pole piece extension at the center of the cone. The phase plug is aluminum and, by design, ensures enhancement of the total inductance profile, providing much of the inductance reduction benefits noted. The phase plug is plated with rose-tinted copper, which by design does not negatively reduce eddy current, and adds thermal dissipation potential, not to mention sleek, class-leading cosmetics. The phase plug extends well down inside the pole vent, and acts as a very large and efficient heatsink for any heat that radiates into the pole. The highest frequencies of audio emanate from the area around the center of the cone and the lower frequencies are produced by the area of the cone that is farther from the center. The phase plug pole piece extension improves the L3SE’s performance and clarity by deflecting delicate midrange and treble tones forward of the driver, while minimizing distortion and improving bandwidth.

The L3SE uses a copper shorting cup. The shorting cup consist of an optimally sized and placed copper (Cu) cup to create a total inductance profile that is not just low, but flat over stroke, frequency, and power. Inductance is the number one limiter of high frequency extension and modulation of

inductance with stroke, frequency and power, and is the primary source of intermodulation distortion (IMD).

Tinsel Leads

The tinsel leads for the L3SE are terminated on one side of the voice coil. The tinsel leads are stitched into the spider and bonded directly to the former and brought out to the terminals, which completely eliminates tinsel lead slap and does not compromise the structural integrity of the cone.

Terminals

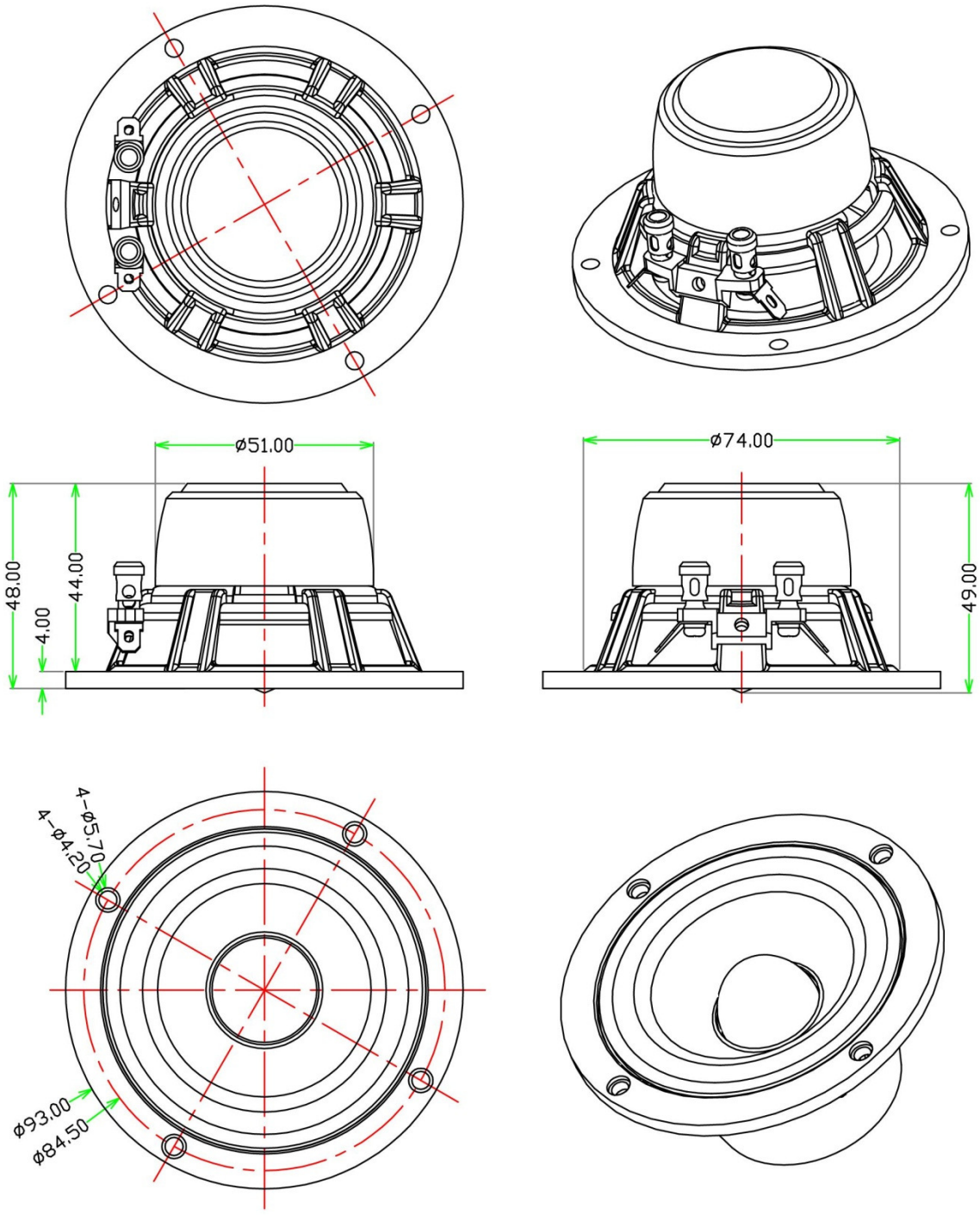
The Legatia L3SE comes equipped with heavy-duty nickel-plated spring-loaded push terminals for both positive and negative, which is an enhancement over the L3V2 model. The terminals optimize contact, and give the end user flexibility in tinned wire or binding post terminations.

Summary

The Legatia L3SE is the world's finest multi-purpose super high-end speaker driver. Mechanical and electrical parameters are amenable to a variety of different installations and speaker locations. This driver is intended to be used in an infinite baffle configuration; a simple, solid baffle, solidly attached to the car's chassis with available airspace at the rear of the baffle is all that is required for optimum operation. The size of the L3SE allows it to be mounted in typical "3-inch" midrange locations within a vehicle, or in custom locations at the discretion of the end-user, as long as there is adequate airspace behind the driver to allow it to maintain proper damping and acoustic suspension.

At home in virtually any arrangement, the L3SE is Hybrid Audio Technologies Legatia SE high-end small-format midrange offering, boasting exceptional performance and a design philosophy that goes hand in hand with true high-fidelity playback.

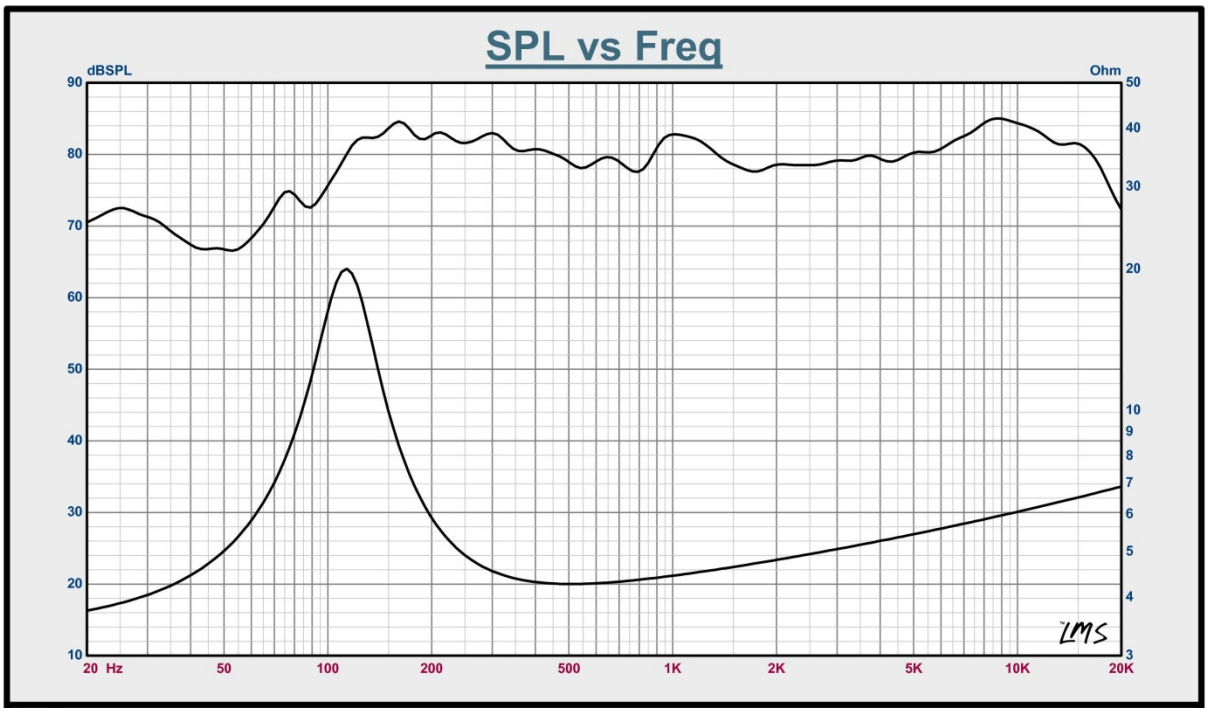
Mechanical Drawing



Thiele/Small Parameters

Overall Diameter	ϕ93 mm (3.7-inch)
Mounting Depth	44 mm
Bolt Circle Diameter	ϕ84.5 mm
Mounting Hole	ϕ74 mm
Recommended *Minimum* Crossover Frequency	185 Hz at 24 dB/octave highpass
P_{nom} Rated Power Input (No Crossover)	30 watts (AES Standard)
P_{max} Rated Power Input (No Crossover)	60 watts (AES Standard)
P_{max} (With Recommended Minimum Crossover)	150 watts
Frequency Range	113 Hz – 18,000 Hz, +/- 3 dB
Sensitivity	89 dB at 2.83V/1meter
Mms	2.46 g
Cms	798 um/N
BL	2.933 T*m
Voice Coil Diameter	25.5 mm (1-inch)
Impedance	4 Ω
DC Resistance	3.2 Ω
Fs	113 Hz (free air)
Qms	3.602
Qes	0.654
Qts	0.553
Xmax	3 mm (one way)
Vas	1.1 L
Sd	3,117 mm^2

Frequency Response Graph



Please note that the response peak at approximately 170 Hz is a testing room mode and is not indicative of the speaker's performance at that frequency. All speakers tested show this same phenomenon, and it has been concluded to be a room artifact.

Legatia L4SE Wide-Bandwidth Midrange/Full-Range

History

The Legatia L4SE's topology is an enhancement of the massively successful first-generation Legatia L4 transducer which was first launched in May 2007.

By early Spring 2010, a beta prototype pair of Legatia L4SE's had been refined after hundreds of hours of testing and development; these highly-evolved drivers were sent to various national- and world-championship competitors, notably including John "Fozz" Myers and Hajji Grape, for real-world evaluation. After countless hours testing the speakers under various circumstances, both as a dedicated midrange and as a wide-bandwidth full-range driver, final approval was given. Production refinements were mid-Summer of 2010, to incorporate features inclusive and proprietary to the Legatia SE line, and final production commenced August 2010. The Legatia L4SE was launched in September 2010 and is the reference 4.65-inch driver in Hybrid Audio's product category known collectively as the Legatia SE Series.

Notably, approximately eight months after launch, using the L4SE's as a dedicated wide-bandwidth midrange driver in his own sound quality competition car, Scott Buwalda set the highest recorded score of all time in organized sound quality competition (996 points) at the IASCA® North American Championships on March 19-20, 2011. This achievement has been memorialized by IASCA® in writing as the highest score on record, and it has been noted by IASCA® that the score achieved will likely remain the highest combined sound quality and installation quality score of all time, in any format, in any part of the world.

Attributes

The Legatia L4SE is a 118mm (4.65-inch) wide-bandwidth midrange/full-range driver to compliment both two-way and three-way system designs, where a point-source midrange and/or full-range driver is required. The following are the L4SE's design attributes:

Basket

The basket of the L4SE is a shared design with the Legatia L4 for easy upgrade potential; the L4 and L4SE are interchangeable in mounting topology. The basket is a high-quality cast aluminum design, and contains a 118mm flange providing for the mounting of the driver via four screw holes (the use of 3mm cap head screws is ideal). The overall dimensions of the driver are very amenable for use in the car audio environment, and in locations typical of the standard "4-inch" driver, or in custom locations at the discretion of the end-user, boasting a depth of just 58mm (2.28-inch). The basket features large openings behind the cone to eliminate chuffing and other aerodynamic-based noises, as well as provides adequate communication to the back of the cone for acoustic suspension and proper operation.

Motor

The motor of the L4SE is paramount to the performance of the driver, providing for a flat and wide BL curve (as a learning note, BL is the equivalent of torque in a car; a car with a flat and constant torque curve provides much better acceleration and performance than a car with a peaky, non-constant

torque curve). The BL curve is flat and extended, yielding 6mm of two-way linear excursion, resulting in the L4SE being able to accurately track the input signal. Reduced distortion and greater dynamics are the immediate sonic benefits. The motor of the L4SE includes an opposing double-stacked NdFeB magnet to improve restorative force, compliance, motor strength, displacement, and power handling. The magnet assemblies are fully surrounded by the voice coil.

Voice Coil

The voice coil diameter of the L4SE is a large 25.5mm (1-inch), which *is* the proper balance between size and moving mass in super high-end mobile audio midranges/full-range drivers. The voice coil diameter serves several key functions: elevated power handling, dissipation of heat (thereby lowering power compression), and maximizing the size of the magnet assembly for enhanced motor compliance. The voice coil is high-purity aluminum, which is superior to copper for heat dissipation, as well as significantly reduced moving mass. The result is an extremely light weight winding with good power handling and low inductance.

Suspension

The inverted surround is butyl rubber which is highly consistent, and does not suffer the variance of natural rubbers. This rubber surround terminates mechanical vibrations well, having a low stiffness for positive damping of resonances. The spider material was chosen for optimal performance; the spider is a 90/10 cotton/Nomex blend with single-dip low viscosity phenolic. This material provides the stiffness desired without being overly brittle or stiff, where vibrations in the spider are well damped and do not translate into the former or the cone.

Cone

Like other Legatia SE midrange designs, you will find no composite or metal cone materials used on the L4SE, as our approach to point-sourcing is to allow the Legatia SE midrange driver to effectively play into upper treble frequencies. The Legatia L4SE is a cone-type driver consisting of a proprietary hybrid paper diaphragm with extremely low moving mass. Paper is widely acknowledged as the best-damping material, as it provides the near optimum balance of strength and weight. The cone has been treated with a water resistant element at the rear to accommodate door mounting, or other areas prone to *occasional* contact with liquid. The cone design offers a wide dispersion pattern to make for flexible installation and speaker location. The Legatia L4SE has an outstanding extended frequency response; the usable frequency range of this driver exceeds seven complete octaves of usable bandwidth on-axis (92 Hz – 18,000+ Hz). Even off-axis, the L4SE faithfully recreates more than five full octaves of information, for the ultimate midrange/full-range driver.

Phase Plug and Shorting Cup

The L4SE comes equipped with a phase plug pole piece extension at the center of the cone. The phase plug is aluminum and, by design, ensures enhancement of the total inductance profile, providing much of the inductance reduction benefits noted. The phase plug is plated with rose-tinted copper, which by design does not negatively reduce eddy current, and adds thermal dissipation potential, not to mention sleek, class-leading cosmetics. The phase plug extends well down inside the pole vent, and acts as a very large and efficient heatsink for any heat that radiates into the pole. The highest frequencies of audio emanate from the area around the center of the cone and the lower frequencies are produced by the area of the cone that is farther from the center. The phase plug pole

piece extension improves the L4SE's performance and clarity by deflecting delicate midrange and treble tones forward of the driver, while minimizing distortion and improving bandwidth.

The L4SE uses a copper shorting cup. The shorting cup consist of an optimally sized and placed copper (Cu) cup to create a total inductance profile that is not just low, but flat over stroke, frequency, and power. Inductance is the number one limiter of high frequency extension and modulation of inductance with stroke, frequency and power, and is the primary source of intermodulation distortion (IMD).

Tinsel Leads

The tinsel leads for the L4SE are terminated on one side of the voice coil. The tinsel leads are stitched into the spider and bonded directly to the former and brought out to the terminals, which completely eliminates tinsel lead slap and does not compromise the structural integrity of the cone.

Terminals

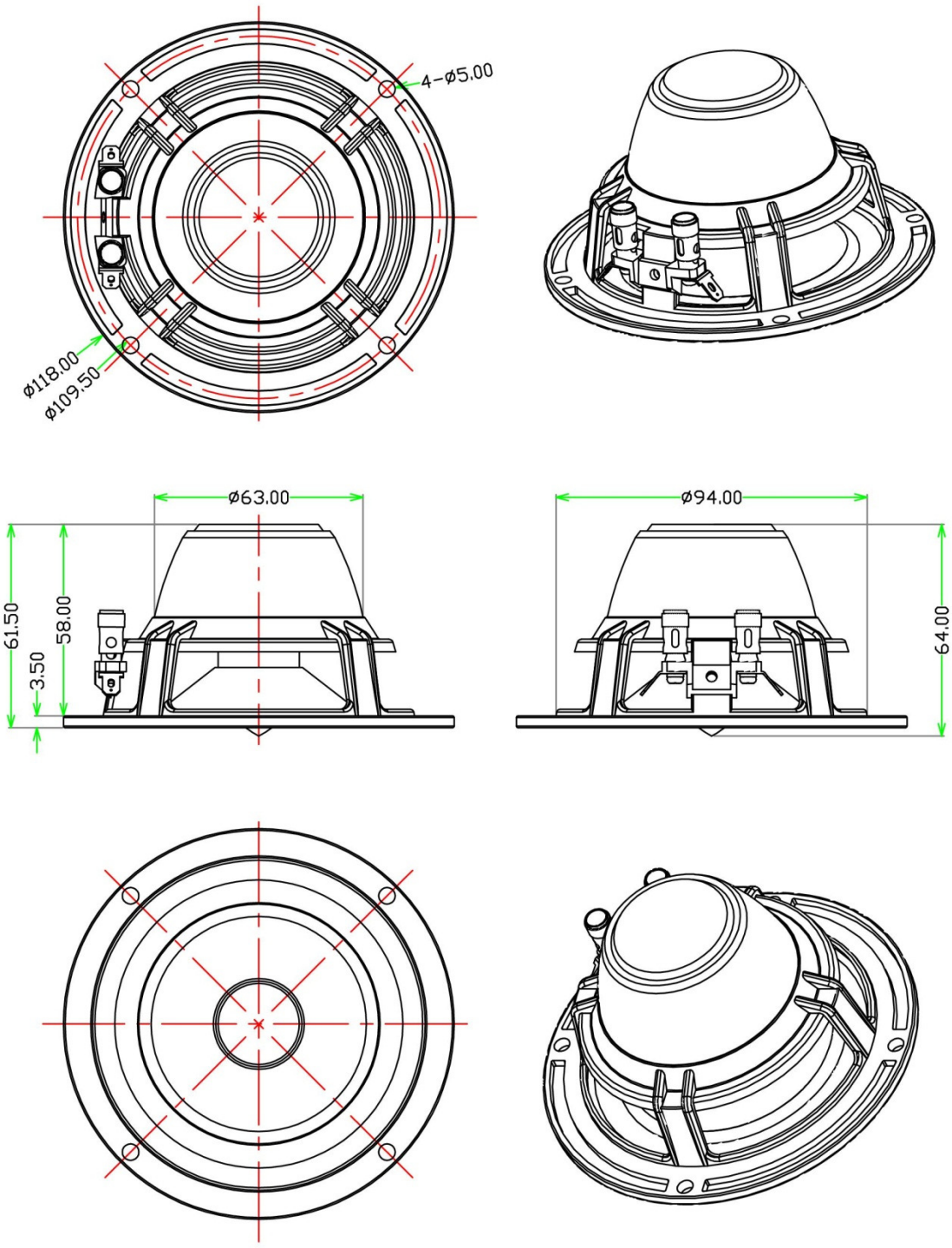
The Legatia L4SE comes equipped with heavy-duty nickel-plated spring-loaded push terminals for both positive and negative, which is an enhancement over the L4 model. The terminals optimize contact, and give the end user flexibility in tinned wire or binding post terminations.

Summary

The Legatia L4SE is the world's finest multi-purpose super high-end speaker driver. Mechanical and electrical parameters are amenable to a variety of different installations and speaker locations. This driver is intended to be used in an infinite baffle configuration; a simple, solid baffle, solidly attached to the car's chassis with available airspace at the rear of the baffle is all that is required for optimum operation. The size of the L4SE allows it to be mounted in typical "4-inch" midrange locations within a vehicle, or in custom locations at the discretion of the end-user, as long as there is adequate airspace behind the driver to allow it to maintain proper damping and acoustic suspension.

At home in virtually any arrangement, the L4SE is Hybrid Audio Technologies Legatia SE high-end midrange offering, boasting exceptional performance and a design philosophy that goes hand in hand with true high-fidelity playback.

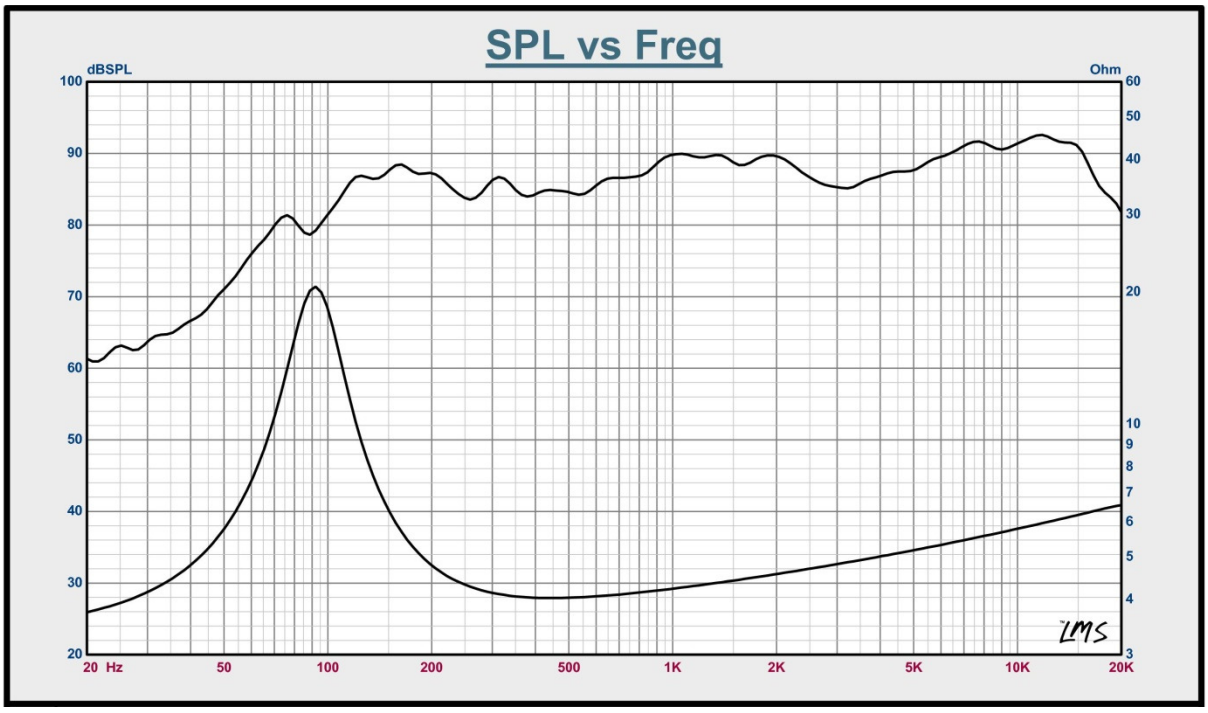
Mechanical Drawing



Thiele/Small Parameters

Overall Diameter	ϕ118 mm (4.65-inch)
Mounting Depth	58 mm
Bolt Circle Diameter	ϕ109.5 mm
Mounting Hole	ϕ94 mm
Recommended *Minimum* Crossover Frequency	150 Hz at 24 dB/octave highpass
P_{nom} Rated Power Input (No Crossover)	35 watts (AES Standard)
P_{max} Rated Power Input (No Crossover)	70 watts (AES Standard)
P_{max} (With Recommended Minimum Crossover)	175 watts
Frequency Range	92 Hz – 18,000 Hz, +/- 3 dB
Sensitivity	91 dB at 2.83V/1meter
Mms	3.632 g
Cms	821 um/N
BL	3.19 T*m
Voice Coil Diameter	25.55 mm (1-inch)
Impedance	4 Ω
DC Resistance	3.2 Ω
Fs	92 Hz (free air)
Qms	3.795
Qes	0.661
Qts	0.563
Xmax	3 mm (one way)
Vas	2.95 L
Sd	5,027 mm^2

Frequency Response Graph



Please note that the response peak at approximately 170 Hz is a testing room mode and is not indicative of the speaker's performance at that frequency. All speakers tested show this same phenomenon, and it has been concluded to be a room artifact.

Legatia L6SE Wide-Bandwidth Midrange/Midbass

History

The Legatia L6SE's topology is an enhanced Special Edition version of the massively successful 'original' first-generation Legatia L6 transducer, which was launched in January 2007 to an enthusiastic reception of car audio competitors, enthusiasts, and car audiophiles. In the years since its inception, the L6 midbass/midrange has been included in several national- and world-championship vehicles and was the midbass of choice for five consecutive years of International Auto Sound Challenge Association (IASCA) domination by Hybrid Audio competitors from 2007 through 2011.

By winter 2009, a beta prototype pair of Legatia L6SE's had been refined after hundreds of hours of testing and development; these highly-evolved drivers were sent to various national- and world-championship competitors, notably including John Sketoe, multi-USACi and IASCA champion, for real-world evaluation. Even before any official launch or announcement of the L6 Special Edition program, John Sketoe competed the Legatia L6SE's as a wide-bandwidth midbass driver in his 1987 Buick Grand National, and went on to win his class with the highest sound quality score of the entire 2009 USACi World Finals event. Before even being released, no less mention of there being an official Special Edition program, the L6SE was already crowned championship-caliber product.

Production refinements were complete and the L6SE's were delivered to an enthusiastic reception on March 18, 2010. Design tenets incorporated features inclusive and proprietary to the Legatia SE line, and the L6SE became the reference 7.1-inch driver in Hybrid Audio's product category known collectively as the Legatia SE Series.

Attributes

The Legatia L6SE is a 181mm (7.1-inch) wide-bandwidth midbass/midrange driver to compliment both two-way and three-way system designs, where a point-source midrange and/or dedicated midbass driver is required. The following are the L6SE's design attributes:

Basket

The basket of the L6SE is a shared design with the Legatia L6 and Legatia L6V2, for easy upgrade potential; the L6SE, L6V2, and L6 are interchangeable in mounting topology. The basket is a high-quality cast aluminum design, and contains a 181mm flange providing for the mounting of the driver via four screw holes (the use of 4mm cap head screws is ideal). The overall dimensions of the driver are very amenable for use in the car audio environment, and in locations typical of the standard "6-inch" driver, or in custom locations at the discretion of the end-user, boasting a depth of 78mm (3.07-inch). The basket features large openings behind the cone to eliminate chuffing and other aerodynamic-based noises, as well as provides adequate communication to the back of the cone for acoustic suspension and proper operation.

Motor

The motor of the L6SE is paramount to the performance of the driver, providing for a flat and wide BL curve (as a learning note, BL is the equivalent of torque in a car; a car with a flat and constant torque

curve provides much better acceleration and performance than a car with a peaky, non-constant torque curve). The BL curve is flat and extended, yielding 18mm of two-way linear excursion, resulting in the L6SE being able to accurately track the input signal. Reduced distortion and greater dynamics are the immediate sonic benefits. The motor of the L6SE includes an opposing double-stacked NdFeB magnet to improve restorative force, compliance, motor strength, displacement, and power handling. The magnet assemblies are fully surrounded by the voice coil.

Voice Coil

The voice coil diameter of the L6SE is a large 35.55mm (1.4-inch), which is the proper balance between size and moving mass in super high-end mobile audio midranges/midbass. The voice coil diameter serves several key functions: elevated power handling, dissipation of heat (thereby lowering power compression), and maximizing the size of the magnet assembly for enhanced motor compliance. The voice coil is high-purity aluminum, which is superior to copper for heat dissipation, as well as significantly reduced moving mass. The result is an extremely light weight winding with good power handling and low inductance.

Suspension

The inverted surround is butyl rubber which is highly consistent, and does not suffer the variance of natural rubbers. This rubber surround terminates mechanical vibrations well, having a low stiffness for positive damping of resonances. The spider material was chosen for optimal performance; the spider is a 90/10 cotton/Nomex blend with single-dip low viscosity phenolic. This material provides the stiffness desired without being overly brittle or stiff, where vibrations in the spider are well damped and do not translate into the former or the cone.

Cone

Like other Legatia SE midrange designs, you will find no composite or metal cone materials used on the L6SE, as our approach to point-sourcing is to allow the Legatia SE midbass/midrange driver to effectively play into middle treble frequencies. The Legatia L6SE is a cone-type driver consisting of a proprietary hybrid paper diaphragm with extremely low moving mass. Paper is widely acknowledged as the best-damping material, as it provides the near optimum balance of strength and weight. The cone has been treated with a water resistant element at the rear to accommodate door mounting, or other areas prone to *occasional* contact with liquid. The cone design offers a wide dispersion pattern to make for flexible installation and speaker location. The Legatia L6SE has an outstanding extended frequency response; the usable frequency range of this driver exceeds seven complete octaves of usable bandwidth on-axis (50 Hz – 10,500+ Hz). Even off-axis, the L6SE faithfully recreates more than five full octaves of information, for the ultimate midrange/full-range driver.

Phase Plug and Shorting Cup

The L6SE comes equipped with a phase plug pole piece extension at the center of the cone. The phase plug is aluminum and, by design, ensures enhancement of the total inductance profile, providing much of the inductance reduction benefits noted. The phase plug is plated with rose-tinted copper, which by design does not negatively reduce eddy current, and adds thermal dissipation potential, not to mention sleek, class-leading cosmetics. The phase plug extends well down inside the pole vent, and acts as a very large and efficient heatsink for any heat that radiates into the pole. The highest frequencies of audio emanate from the area around the center of the cone and the lower

frequencies are produced by the area of the cone that is farther from the center. The phase plug pole piece extension improves the L6SE's performance and clarity by deflecting delicate midrange and treble tones forward of the driver, while minimizing distortion and improving bandwidth.

The L6SE uses a copper shorting cup. The shorting cup consist of an optimally sized and placed copper (Cu) cup to create a total inductance profile that is not just low, but flat over stroke, frequency, and power. Inductance is the number one limiter of high frequency extension and modulation of inductance with stroke, frequency and power, and is the primary source of intermodulation distortion (IMD).

Tinsel Leads

The tinsel leads for the L6SE are terminated on one side of the voice coil, with a second, unused set of tinsel leads exiting the opposite side of the termination. Having two sets of tinsel leads reduces the rocking of the system under high stroke; the spider is mechanically balanced. Additionally the tinsel leads are stitched into the spider and bonded directly to the former and brought out to the terminals, which completely eliminates tinsel lead slap and does not compromise the structural integrity of the cone.

Terminals

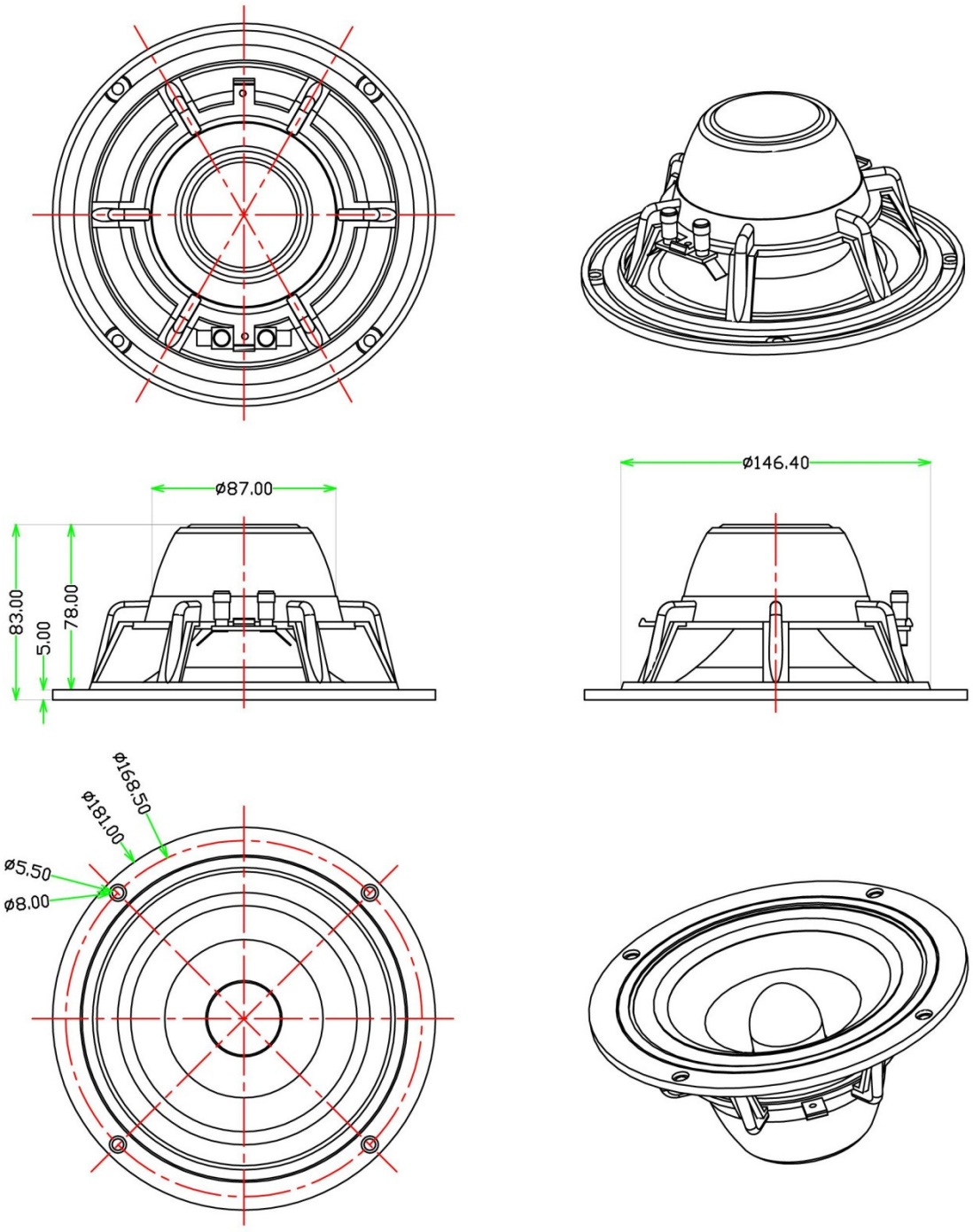
The Legatia L6SE comes equipped with heavy-duty nickel-plated spring-loaded push terminals for both positive and negative. The terminals optimize contact, and give the end user flexibility in tinned wire or binding post terminations.

Summary

The Legatia L6SE is the ideal multi-purpose super high-end speaker driver. Mechanical and electrical parameters are amenable to a variety of different installations and speaker locations. This driver is intended to be used in an infinite baffle configuration; a simple, solid baffle, solidly attached to the car's chassis with available airspace at the rear of the baffle is all that is required for optimum operation. The size of the L6SE allows it to be mounted in typical "6-inch" midbass locations within a vehicle, or in custom locations at the discretion of the end-user, as long as there is adequate airspace behind the driver to allow it to maintain proper damping and acoustic suspension.

At home in virtually any arrangement, the L6SE is Hybrid Audio Technologies Legatia SE high-end large-format midrange/midbass offering, boasting exceptional performance and a design philosophy that goes hand in hand with true high-fidelity playback.

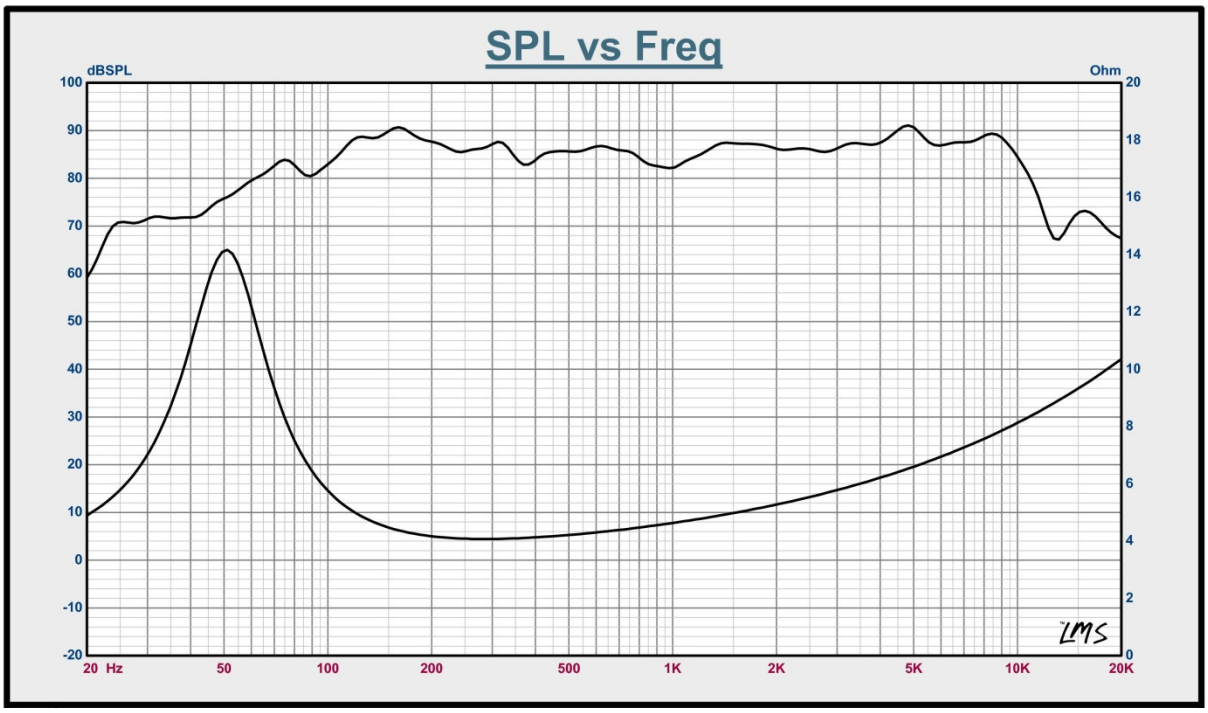
Mechanical Drawing



Thiele/Small Parameters

Overall Diameter	ϕ181 mm (7.1-inch)
Mounting Depth	78 mm
Bolt Circle Diameter	ϕ167.5 mm
Mounting Hole	ϕ146.5 mm
Recommended *Minimum* Crossover Frequency	45 Hz at 24 dB/octave highpass
P_{nom} Rated Power Input (No Crossover)	85 watts (AES Standard)
P_{max} Rated Power Input (No Crossover)	170 watts (AES Standard)
P_{max} (With Recommended Minimum Crossover)	225 watts
Frequency Range	50 Hz – 10,000 Hz, +/- 3 dB
Sensitivity	92.5 dB at 2.83V/1meter
Mms	13.466 g
Cms	721 um/N
BL	4.898 T*m
Voice Coil Diameter	35.55 mm (1.4-inch)
Impedance	4 Ω
DC Resistance	3.2 Ω
Fs	50 Hz (free air)
Qms	1.941
Qes	0.612
Qts	0.466
Xmax	9 mm (one way)
Vas	18.6 L
Sd	13,478 mm^2

Frequency Response Graph



Please note that the response peak at approximately 170 Hz is a testing room mode and is not indicative of the speaker's performance at that frequency. All speakers tested show this same phenomenon, and it has been concluded to be a room artifact.

Legatia L8SE Wide-Bandwidth Midrange/Midbass

History

The Legatia SE L8SE's topology is an enhanced Special Edition version of the massively successful 'original' first-generation Legatia L8 transducer, as well as the "version 2" Legatia L8V2.

By Summer 2010, a beta prototype pair of Legatia L8SE's had been refined after hundreds of hours of testing and development; these highly-evolved drivers were tested in Scott Buwalda's very own competition vehicle, as well as by Jorge Juaristi, multiple Mexican USACi champion. Production refinements were complete and the L8SE's were delivered to an enthusiastic reception on October 26, 2010. Design tenets incorporated features inclusive and proprietary to the Legatia SE line, and the L8SE became the reference 8.85-inch driver in Hybrid Audio's product category known collectively as the Legatia SE Series.

Approximately five months after launch, using the L8SE's as a dedicated midbass driver in his own sound quality competition car, Scott Buwalda set the highest recorded score of all time in organized sound quality competition (996 points) at the IASCA® North American Championships on March 19-20, 2011. This achievement has been memorialized by IASCA® in writing as the highest score on record, and it has been noted by IASCA that the score achieved will likely remain the highest combined sound quality and installation quality score of all time, in any format, in any part of the world.

Attributes

The Legatia L8SE is a 225mm (8.85-inch) "large format" wide-bandwidth midbass/midrange driver to compliment both two-way and three-way system designs, where a point-source midrange and/or dedicated midbass driver is required. The following are the L8SE's design attributes:

Basket

The basket of the L8SE is a shared design with the Stage V Legatia L8V2 for easy upgrade potential; the L8SE and L8V2 are interchangeable in mounting topology. The L8SE differs from the first-version L8 in that the basket geometry has been enhanced in the SE model, just in the same way the V2 model was enhanced, to a slightly larger outside diameter for greater clamping surface area (from 8.5-inch on the L8 to 8.85-inch on the L8SE and L8V2); the mounting holes for each driver remain nearly identical however, with a difference of only 2mm (188mm verses 186mm). Provided enough outside mounting diameter difference can be obtained, the L8SE will often fit into the first-generation L8's mounting hole.

The basket is a high-quality cast aluminum design, and contains a 225mm flange providing for the mounting of the driver via four screw holes (the use of 5mm cap head screws is ideal). The overall dimensions of the driver are very amenable for use in the car audio environment, and in locations typical of the standard "8-inch" driver, or in custom locations at the discretion of the end-user, boasting a depth of 94mm (3.7-inch). The basket features large openings behind the cone to eliminate chuffing and other aerodynamic-based noises, as well as provides adequate communication to the back of the cone for acoustic suspension and proper operation.

Motor

The motor of the L8SE is paramount to the performance of the driver, providing for a flat and wide BL curve (as a learning note, BL is the equivalent of torque in a car; a car with a flat and constant torque curve provides much better acceleration and performance than a car with a peaky, non-constant torque curve). The BL curve is flat and extended, yielding 19mm of two-way linear excursion, resulting in the L8SE being able to accurately track the input signal. Reduced distortion and greater dynamics are the immediate sonic benefits. The motor of the L8SE includes an opposing double-stacked NdFeB magnet to improve restorative force, compliance, motor strength, displacement, and power handling. The magnet assemblies are fully surrounded by the voice coil.

Voice Coil

The voice coil diameter of the L8SE is a large 35.55mm (1.4-inch), which is the proper balance between size and moving mass in super high-end mobile audio midranges/midbass. The voice coil diameter serves several key functions: elevated power handling, dissipation of heat (thereby lowering power compression), and maximizing the size of the magnet assembly for enhanced motor compliance. The voice coil is high-purity aluminum, which is superior to copper for heat dissipation, as well as significantly reduced moving mass. The result is an extremely light weight winding with good power handling and low inductance.

Suspension

The inverted surround is butyl rubber which is highly consistent, and does not suffer the variance of natural rubbers. This rubber surround terminates mechanical vibrations well, having a low stiffness for positive damping of resonances. The spider material was chosen for optimal performance; the spider is a 90/10 cotton/Nomex blend with single-dip low viscosity phenolic. This material provides the stiffness desired without being overly brittle or stiff, where vibrations in the spider are well damped and do not translate into the former or the cone.

Cone

Like other Legatia SE midrange designs, you will find no composite or metal cone materials used on the L8SE, as our approach to point-sourcing is to allow the Legatia SE midbass/midrange driver to effectively play into middle and upper midrange frequencies. The Legatia L8SE is a cone-type driver consisting of a proprietary hybrid paper diaphragm with extremely low moving mass. Paper is widely acknowledged as the best-damping material, as it provides the near optimum balance of strength and weight. The cone has been treated with a water resistant element at the rear to accommodate door mounting, or other areas prone to *occasional* contact with liquid. The cone design offers a wide dispersion pattern to make for flexible installation and speaker location. The Legatia L8SE has an outstanding extended frequency response; the usable frequency range of this driver exceeds seven complete octaves of usable bandwidth on-axis (40 Hz – 5,000+ Hz). Even off-axis, the L8SE faithfully recreates more than five full octaves of information, for the ultimate midrange/full-range driver.

Phase Plug and Shorting Cup

The L8SE comes equipped with a phase plug pole piece extension at the center of the cone. The phase plug is aluminum and, by design, ensures enhancement of the total inductance profile, providing much of the inductance reduction benefits noted. The phase plug is plated with rose-tinted

copper, which by design does not negatively reduce eddy current, and adds thermal dissipation potential, not to mention sleek, class-leading cosmetics. The phase plug extends well down inside the pole vent, and acts as a very large and efficient heatsink for any heat that radiates into the pole. The highest frequencies of audio emanate from the area around the center of the cone and the lower frequencies are produced by the area of the cone that is farther from the center. The phase plug pole piece extension improves the L8SE's performance and clarity by deflecting delicate midrange and treble tones forward of the driver, while minimizing distortion and improving bandwidth.

The L8SE uses a copper shorting cup. The shorting cup consist of an optimally sized and placed copper (Cu) cup to create a total inductance profile that is not just low, but flat over stroke, frequency, and power. Inductance is the number one limiter of high frequency extension and modulation of inductance with stroke, frequency and power, and is the primary source of intermodulation distortion (IMD).

Tinsel Leads

The tinsel leads for the L8SE are terminated on one side of the voice coil, with a second, unused set of tinsel leads exiting the opposite side of the termination. Having two sets of tinsel leads reduces the rocking of the system under high stroke; the spider is mechanically balanced. Additionally the tinsel leads are bonded directly to the former and brought out to the terminals, which keeps tinsel lead slap to a minimum and does not compromise the structural integrity of the cone.

Terminals

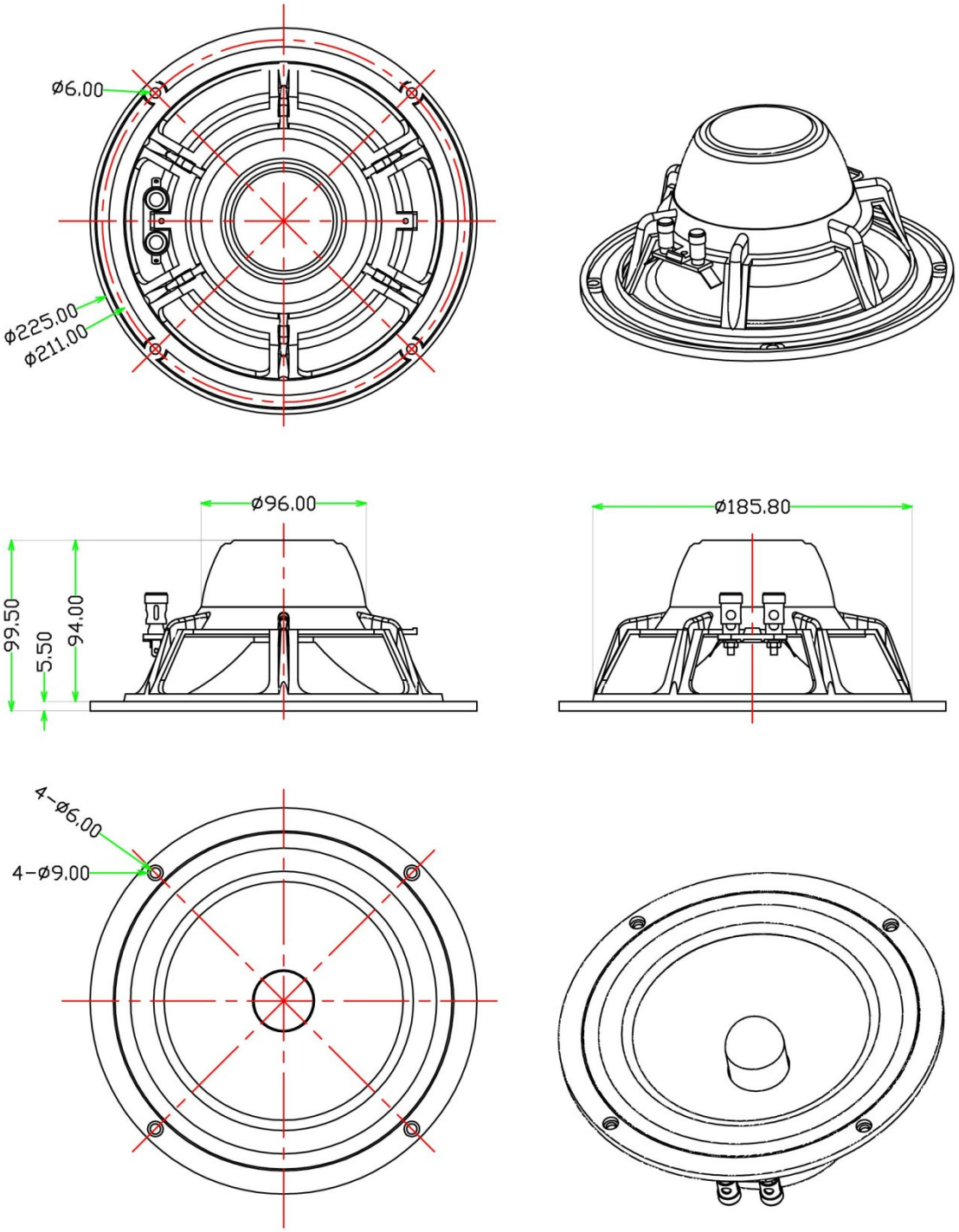
The Legatia L8SE comes equipped with heavy-duty spring loaded brass core terminals that are nickel plated to optimize contact, and give the end user flexibility in tinned wire or binding post terminations. The terminals are designed to accept up to 10-gauge wiring.

Summary

The Legatia L8SE is the ideal multi-purpose super high-end speaker driver. Mechanical and electrical parameters are amenable to a variety of different installations and speaker locations. This driver is intended to be used in an infinite baffle configuration; a simple, solid baffle, solidly attached to the car's chassis with available airspace at the rear of the baffle is all that is required for optimum operation. The size of the L8SE allows it to be mounted in typical "8-inch" midbass locations within a vehicle, or in custom locations at the discretion of the end-user, as long as there is adequate airspace behind the driver to allow it to maintain proper damping and acoustic suspension.

At home in virtually any arrangement, the L8SE is Hybrid Audio Technologies Legatia SE high-end large-format midrange/midbass offering, boasting exceptional performance and a design philosophy that goes hand in hand with true high-fidelity playback.

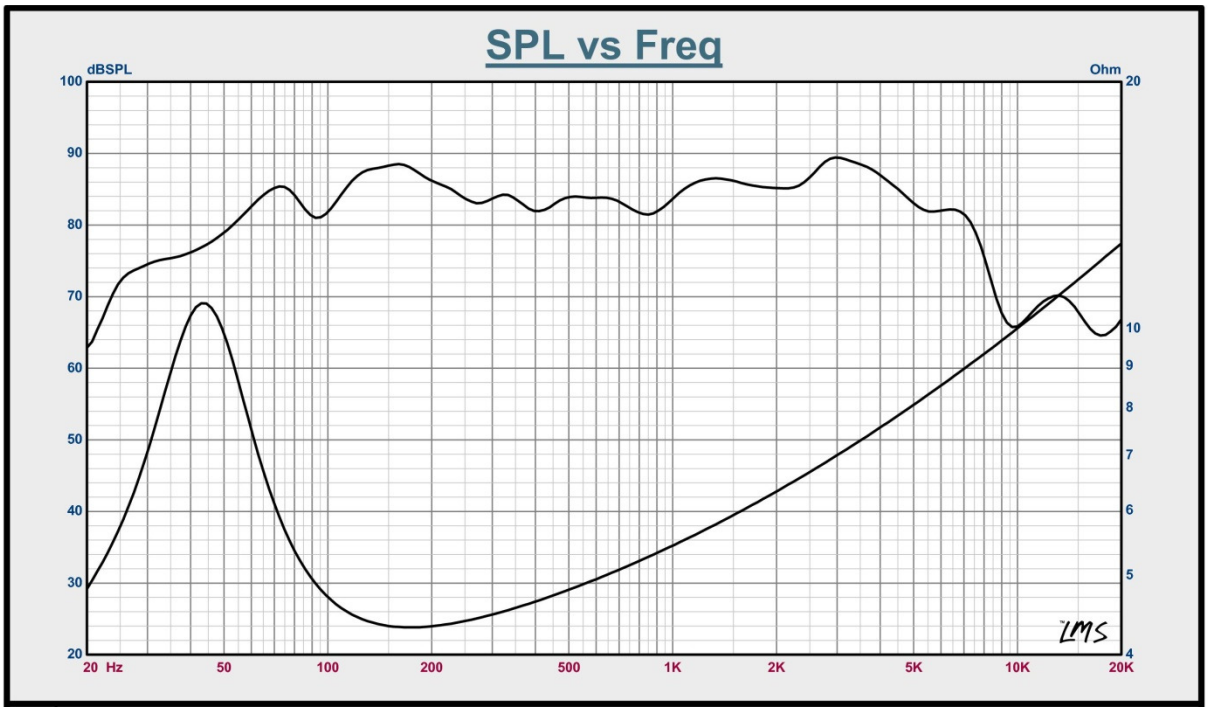
Mechanical Drawing



Thiele/Small Parameters

Overall Diameter	ϕ225 mm (8.85-inch)
Mounting Depth	94 mm
Bolt Circle Diameter	ϕ211 mm
Mounting Hole	ϕ186 mm
Recommended *Minimum* Crossover Frequency	40 Hz at 24 dB/octave highpass
P_{nom} Rated Power Input (No Crossover)	90 watts (AES Standard)
P_{max} Rated Power Input (No Crossover)	180 watts (AES Standard)
P_{max} (With Recommended Minimum Crossover)	240 watts
Frequency Range	40 Hz – 3,800 Hz, +/- 3 dB
Sensitivity	92 dB at 2.83V/1meter
Mms	30.0 g
Cms	433 um/N
BL	5.997 T*m
Voice Coil Diameter	35.55 mm (1.4-inch)
Impedance	4 Ω
DC Resistance	3.4 Ω
Fs	41.5 Hz (free air)
Qms	1.966
Qes	0.914
Qts	0.627
Xmax	9.5 mm (one way)
Vas	27.5 L
Sd	21,124 mm^2

Frequency Response Graph



Please note that the response peak at approximately 170 Hz is a testing room mode and is not indicative of the speaker's performance at that frequency. All speakers tested show this same phenomenon, and it has been concluded to be a room artifact.

Stage V Legatia L2x Two-Way Vertically-Biamplified Passive Crossover

NOTE: Although the Legatia L2x is listed in the Stage V Legatia series, it has multiple complimentary uses for Stage VI Legatia SE products as well, given the complimentary crossover topology and use of low-tolerance, asymmetrically-aligned componentry and lack of board-mounted equalization.

History

The Legatia L2x topology is an enhanced Stage V version of the Stage IV Clarus C2x passive crossover network, which was first released with the Clarus C61-2 set in January 2008. It's no secret that Hybrid Audio Technologies highly recommends the use of active crossovers that are set-up and adjusted by an industry specialist, such as a master tuner, or a highly-qualified car audio shop installer (please read any number of White Papers on the subject of passive crossovers on the www.hybrid-audio.com/downloads.htm web page). In some cases, however, using active crossovers is not a viable option, so we designed and manufactured the Legatia L2x to allow for easy Legatia installations, especially when multiple amplifier channels and/or adequate active crossover processing was not available in the car audio installation.

The L2x can be used for two-way passively crossed-over systems, or used as the two-way dividing network for midrange and treble drivers in a "quasi-active" three-way (six speaker) system, where the midbass is actively crossed-over at the amplifier.

The L2x is based loosely off of the Clarus C2x crossover, with key enhancements, including the option for vertical bi-wiring, as well as an enhanced filter set using low-tolerance, super high-quality componentry. The Legatia L2x was launched in September 2009 and is the reference two-way passive crossover in Hybrid Audio's product category known collectively as the Legatia Series.

Key Issues in Passive Crossover Design

Before highlighting the L2x's design attributes, there are certain key issues in passive crossover design that the end-user should be aware of. For years, vocal manufacturers have coerced the consumer into believing that capacitors, coils, and resistors are not only desirable, but are a requirement. One notable "high-end" speaker manufacturer boasts that they spend "months" working on crossover designs to 'enhance' their speakers. To 'enhance' means to add considerable filtering to fix speaker response anomalies, aka poor speaker designs.

Our speaker design philosophy is to spend the time and resources necessary to make the speakers exceptional in the design phase, and then use simpleton filtering to protect only for thermal protection at resonance and provide the desired frequency response filtering via crossovers. It is our philosophy that the passive crossover should not contain any level of equalization; none of our designs, in any series, use crossovers that contain any form of equalization beyond simple tweeter attenuation. We believe in making the speaker great, not trying to fix a poor speaker with filtering and attenuation. There's no crossover in the world that can make a poorly-designed speaker sound good. This is why there's a relatively simple, high-quality crossover topology employed on the Legatia L2x crossover, with no additional board-mounted equalization. And this is also why we implore you to use our world-class speaker systems in concert with the L2x.

Attributes

The Legatia L2x is a bi-amplified two-way passive crossover for use with virtually any midrange, midbass and tweeter pairing Hybrid Audio manufactures. The following are the L2x's design attributes:

Filter Set

The L2x is a bi-wired two-way passive crossover that has the following filters:

Lowpass (midrange): 5,700 Hz at 12 dB/octave Linkwitz Riley
Highpass (treble): 5,200 Hz at 12 dB/octave Linkwitz Riley

The only filtering on the board is mentioned above, and in essence are elementary highpass and lowpass filters common in any two-way crossover design. As noted above, there is no board-mounted equalization specific to one brand or type of midrange or tweeter, or common of competitor's designs where equalization correction (filtering) is added. The L2x can be used with any number of drivers we produce (including any midrange, midbass, and tweeter from the Imagine, Unity, Clarus, Legatia, Legatia SE, and Legatia SE Pro range of offerings). The more common uses for the L2x are Legatia L6SE, paired with Legatia SE L1 Pro, or Legatia SE L1 Pro R2, but the design is not limited to those uses and can be expanded to any number of possible bespoke two-way configurations, or used as the two-way dividing network for midrange and treble drivers in a "quasi-active" three-way system, where the midbass is actively cross-over at the amplifier.

The L2x passive crossover networks incorporate super high quality and low tolerance metalized polypropylene film capacitors, air-core inductors, and low tolerance non-inductive resistors. No output level switches were used in the passive crossover design because switches add a resistive effect and are typically of extremely low quality. Additionally, "jumper pins" add an unnecessary pair of splices in the signal path to the tweeter, and were not included in our design either. Rather, all tweeter level adjustments are done on the board level with dedicated non-inductive resistors; tweeter attenuation is accomplished by selecting the appropriate output (-3 dB, 0 dB, or +3 dB) on the passive crossover circuit board. The components selected are complimentary and ensure no appreciable signal degradation between the input and output side of the crossovers. Likewise, the capacitors and inductors are arranged on the board to reduce the coupling between circuits and electromagnetic interference by basic physical separation, while still keeping the footprint size of the circuit board small. Finally, the use of 12 dB/octave filters on both low pass and high pass minimizes phase-related distortion typical of crossovers with mismatched orders, and ensures *relative* phase-coherency.

Connection

The L2x has convenient spring-loaded terminals for wire connection. Bare wire can be twisted tightly and inserted into the spring-loaded terminal, however Hybrid Audio recommends that the wire be tinned with solder to avoid oxidation, fraying, and to promote a better connection. The following is the connection nomenclature on the L2x, from left to right on the circuit board:

+WF Woofer positive input from amplifier
IN - Woofer negative input from amplifier
+WF Woofer positive output to Hybrid Audio Technologies midbass or midrange positive terminal

OUT - Woofer negative output to Hybrid Audio Technologies midbass or midrange negative terminal
+ TW Tweeter positive input from amplifier
IN - Tweeter negative input from amplifier
HI + Tweeter positive output to Hybrid Audio Technologies tweeter positive terminal, +3 dB setting
MID + Tweeter positive output to Hybrid Audio Technologies tweeter positive terminal, 0 dB setting
LOW + Tweeter positive output to Hybrid Audio Technologies tweeter positive terminal, -3 dB setting
TW - Tweeter negative output to Hybrid Audio Technologies tweeter negative terminal

NOTE: the L2x is a bi-wired crossover, meaning the crossover has two sets of inputs for use with two two-channel amplifiers or a four-channel amplifier. If you wish to not use two two-channel amplifiers or a four-channel amplifier, and use only one two-channel amplifier instead, simply "bridge" the connections between + WF and + TW and IN – and IN – with two short strands of insulated wire.

Once all speakers are installed, you will need to do a brief listening test with CD-quality music that you are intimately familiar with to determine which tweeter attenuation you desire. Be sure that all equalization, bass, and treble levels are defeated or set to "zero" on the source unit before evaluating the intensity of the tweeters with respect to your midrange/midbass level and your listening taste. Note also, after approximately 25 hours, the speakers will begin to "break in", like any mechanical component, and intensities may need to be re-adjusted again. In other words, *the midbass need to be broken in with typical play-time before final tweeter attenuation is set*. You may find that after break-in, the tweeter intensity will need to be re-adjusted.

Mounting

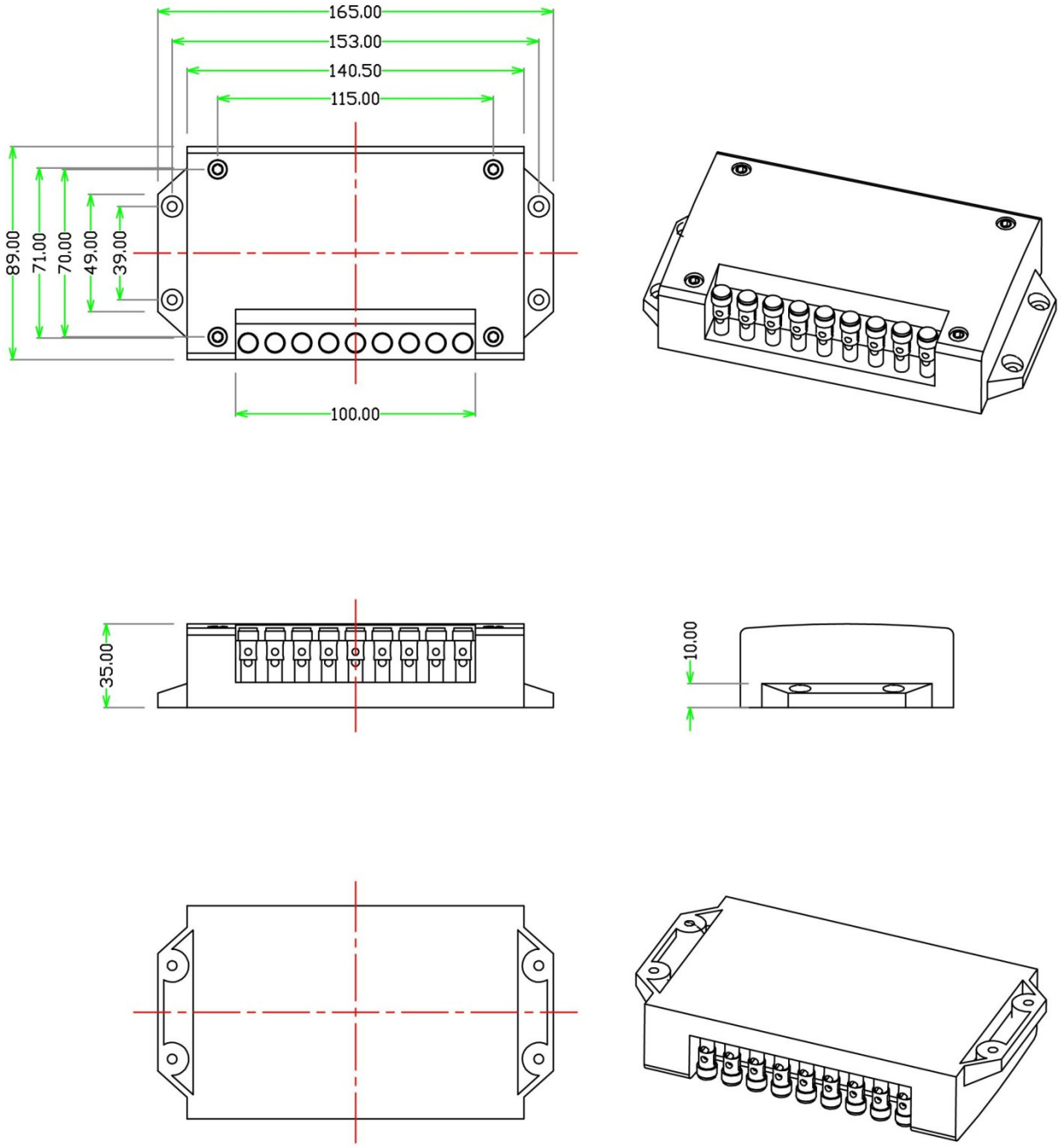
Choose your L2x mounting location carefully. The L2x contains parts that are susceptible to damage through repeated shock, moisture, and electromagnetic interference. For example, it is advisable to install the passive crossovers inside the passenger compartment versus the door, since the door is exposed to repeated opening and closing "shock" which may damage the delicate passive crossover components, or cause soldered joints to break over time. Likewise, moisture may be present in a door installation. Finally, if you are mounting the passive crossovers in the kick panels or dashboard, be sure to keep the networks away from any noise-inducing device within the vehicle, such as factory ECU's, auto transmission control ECU's, BCM's, alternator field/stator wiring, and numerous other devices. Readers note: be mindful of the location of throttle, brake, and clutch pedals when you are selecting a mounting location and where to route the speaker wiring.

If the *only* option for crossover mounting is in the door, it would typically be prudent to install the passive crossovers immediately adjacent to the midbass location to keep speaker wiring and connections short and allow access to the OEM wiring, if it is used, without having to extend it and creating an additional resistive splice in the wire. If you must install the L2x in the door, DO NOT MOUNT THE CROSSOVER INSIDE THE DOOR CAVITY! Rather, install the networks on the same mounting plane as the midbass, toward the passenger compartment, and behind the OEM door panel/skin, so as to not expose the delicate electronic parts contained within to moisture inside the door cavity. Once an adequate spot for mounting the L2x is found, securely mount the crossover networks using the supplied screws. Before any cutting, drilling, or insertion of screws, check the clearance of the panel from behind to verify that you won't be damaging existing wiring, window or door lock motors, window tracks and the windows themselves, and etc.

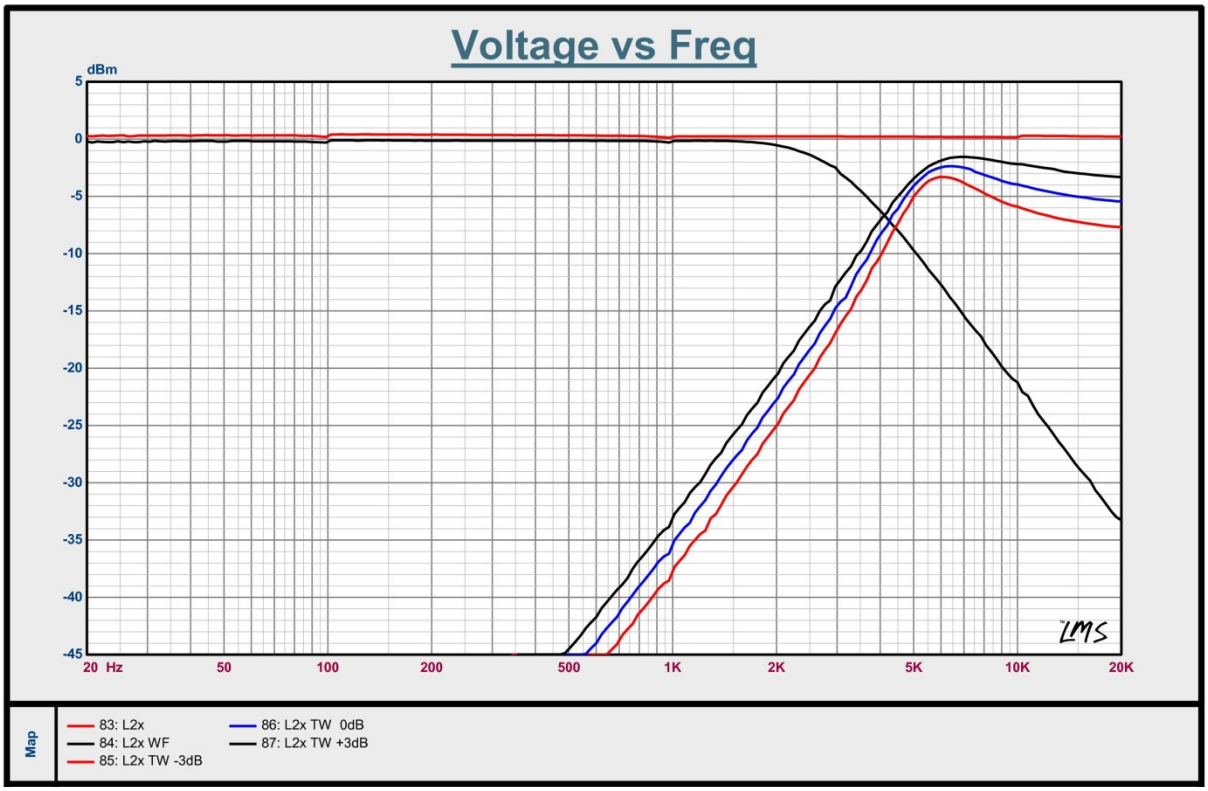
Summary

The Legatia L2x is an exceptional-quality two-way passive crossover device that can be used with any Hybrid Audio speaker system to accommodate any number of different bespoke system designs. At home in virtually any arrangement, the L2x is Hybrid Audio Stage V high-end two-way passive crossover, boasting exceptional performance and a design philosophy that goes hand in hand with true high-fidelity playback.

Mechanical Drawing



Frequency Filter Plot



Stage V Legatia L3x Three-Way Vertically-Biamplified Passive Crossover

NOTE: Although the Legatia L2x is listed in the Stage V Legatia series, it has multiple complimentary uses for Stage VI Legatia SE products as well, given the complimentary crossover topology and use of low-tolerance, asymmetrically-aligned componentry and lack of board-mounted equalization.

History

The Legatia L3x topology is loosely based off of the Legatia SE L2x crossover topology, which was first released in October 2009. It's no secret that Hybrid Audio Technologies highly recommends the use of active crossovers that are set-up and adjusted by an industry specialist, such as a master tuner, or a highly-qualified car audio shop installer (please read any number of White Papers on the subject of passive crossovers on the www.hybrid-audio.com/downloads.htm web page). In some cases, however, using active crossovers is not a viable option, so we designed and manufactured the Legatia L3x to allow for easy Legatia SE installations, especially when multiple amplifier channels and/or adequate active crossover processing was not available in the car audio installation.

The L3x can be used for virtually any Legatia SE three-way passively crossed-over systems, or used in conjunction with other Hybrid Audio products to create a truly "bespoke" three-way system. The Legatia L3x was launched in June 2011 and is the reference three-way passive crossover in Hybrid Audio's product category known collectively as the Legatia Series.

Key Issues in Passive Crossover Design

Before highlighting the L3x's design attributes, there are certain key issues in passive crossover design that the end-user should be aware of. For years, vocal manufacturers have coerced the consumer into believing that capacitors, coils, and resistors are not only desirable, but are a requirement. One notable "high-end" speaker manufacturer boasts that they spend "months" working on crossover designs to 'enhance' their speakers. To 'enhance' means to add considerable filtering to fix speaker response anomalies, aka poor speaker designs.

Our speaker design philosophy is to spend the time and resources necessary to make the speakers exceptional in the design phase, and then use simpleton filtering to protect only for thermal protection at resonance and provide the desired frequency response. It is our philosophy that the passive crossover should not contain any level of equalization; none of our designs, in any series, use crossovers that contain any form of equalization beyond simple tweeter attenuation. We believe in making the speaker great, not trying to fix a poor speaker with filtering and attenuation. There's no crossover in the world that can make a poorly-designed speaker sound good. This is why there's a relatively simpleton, high-quality crossover topology employed on the Legatia L3x crossover, with no additional board-mounted equalization. And this is also why we implore you to use our world-class speaker systems in concert with the L3x.

Attributes

The Legatia L3x is a bi-amplified three-way passive crossover for use with virtually any midrange, midbass and tweeter pairing Hybrid Audio manufactures. The following are the L3x's design attributes:

Filter Set

The L3x is a bi-wired three-way passive crossover that has the following filters:

Lowpass (midbass): 300 Hz at 12 dB/octave Linkwitz Riley
Bandpass (midrange): 300 Hz to 6,000 Hz at 12 dB/octave Linkwitz Riley
Highpass (treble): 6,000 Hz at 12 dB/octave Linkwitz Riley

The only filtering on the board is mentioned above, and in essence are elementary highpass, bandpass, and lowpass filters common in any three-way crossover design. As noted above, there is no board-mounted equalization specific to one brand or type of midrange or tweeter, or common of competitor's designs where equalization correction (filtering) is added. The L3x can be used with any number of drivers we produce (including any midrange, midbass, and tweeter from the Imagine, Unity, Clarus, Legatia SE, Legatia SE SE, and Legatia SE Pro range of offerings). The more common uses for the L3x are Legatia L6SE, paired with Legatia L3SE or L4SE, and Legatia SE tweeters, such as the Legatia SE L1 Pro, or Legatia SE L1 Pro R2, but the design is not limited to those uses and can be expanded to any number of possible bespoke three-way configurations.

The L3x passive crossover networks incorporate asymmetrically arranged super high quality and low tolerance metalized polypropylene film capacitors, air-core inductors, and low tolerance non-inductive resistors. Even the massive lowpass and bandpass capacitors are super high-quality polypropylene capacitors, nearly unheard of by today's standards. No output level switches were used in the passive crossover design because switches add a resistive effect and are typically of extremely low quality. Additionally, "jumper pins" add an unnecessary pair of splices in the signal path to the tweeter, and were not included in our design either. Rather, all tweeter level adjustments are done on the board level with dedicated non-inductive resistors; tweeter attenuation is accomplished by selecting the appropriate output (-3 dB, 0 dB, or +3 dB) on the passive crossover circuit board. Likewise, midrange attenuation is accomplished by selecting the appropriate output (0 dB or -3 dB). The components selected are complimentary and ensure no appreciable signal degradation between the input and output side of the crossovers. Likewise, the capacitors and inductors are arranged on the board to reduce the coupling between circuits and electromagnetic interference by basic physical separation, while still keeping the footprint size of the circuit board small. Finally, the use of 12 dB/octave filters on both low pass and high pass minimizes phase-related distortion typical of crossovers with mismatched orders, and ensures *relative* phase-coherency.

Connection

The L3x has convenient spring-loaded terminals for wire connection. Bare wire can be twisted tightly and inserted into the spring-loaded terminal, however Hybrid Audio recommends that the wire be tinned with solder to avoid oxidation, fraying, and to promote a better connection. The following is the connection nomenclature on the L3x, from left to right on the circuit board:

+WF	Woofer positive input from amplifier
IN -	Woofer negative input from amplifier
+WF	Woofer positive output to Hybrid Audio Technologies midbass or midrange positive terminal
OUT -	Woofer negative output to Hybrid Audio Technologies midbass or midrange negative terminal
+M/TW	Midrange and tweeter positive input from amplifier
IN -	Midrange and tweeter negative input from amplifier

+M/H Midrange positive output to Hybrid Audio Technologies midrange positive terminal, 0 dB setting
+M/L Midrange positive output to Hybrid Audio Technologies midrange positive terminal, -3 dB setting
+T/H Tweeter positive output to Hybrid Audio Technologies tweeter positive terminal, +3 dB setting
+T/M Tweeter positive output to Hybrid Audio Technologies tweeter positive terminal, 0 dB setting
+T/L Tweeter positive output to Hybrid Audio Technologies tweeter positive terminal, -3 dB setting
TW - Tweeter negative output to Hybrid Audio Technologies tweeter negative terminal

NOTE: the L3x is a bi-wired crossover, meaning the crossover has two sets of inputs for use with two two-channel amplifiers or a four-channel amplifier. If you wish to not use two two-channel amplifiers or a four-channel amplifier, and use only one two-channel amplifier instead, simply "bridge" the connections between + WF and + M/T and IN – and IN – with two short strands of insulated wire.

Once all speakers are installed, you will need to do a brief listening test with CD-quality music that you are intimately familiar with to determine which midrange and/or tweeter attenuation you desire. Be sure that all equalization, bass, and treble levels are defeated or set to "zero" on the source unit before evaluating the intensity of the tweeters with respect to your midrange/midbass level and your listening taste. Note also, after approximately 25 hours, the speakers will begin to "break in", like any mechanical component, and intensities may need to be re-adjusted again. In other words, *the midbass and midrange need to be broken in with typical play-time before final midrange and tweeter attenuation is set*. You may find that after break-in, the midrange and/or tweeter intensity will need to be re-adjusted.

Mounting

Choose your L3x mounting location carefully. The L3x contains parts that are susceptible to damage through repeated shock, moisture, and electromagnetic interference. For example, it is advisable to install the passive crossovers inside the passenger compartment versus the door, since the door is exposed to repeated opening and closing "shock" which may damage the delicate passive crossover components, or cause soldered joints to break over time. Likewise, moisture may be present in a door installation. Finally, if you are mounting the passive crossovers in the kick panels or dashboard, be sure to keep the networks away from any noise-inducing device within the vehicle, such as factory ECU's, auto transmission control ECU's, BCM's, alternator field/stator wiring, and numerous other devices. Readers note: be mindful of the location of throttle, brake, and clutch pedals when you are selecting a mounting location and where to route the speaker wiring.

If the *only* option for crossover mounting is in the door, it would typically be prudent to install the passive crossovers immediately adjacent to the midbass location to keep speaker wiring and connections short and allow access to the OEM wiring, if it is used, without having to extend it and creating an additional resistive splice in the wire. If you must install the L3x in the door, DO NOT MOUNT THE CROSSOVER INSIDE THE DOOR CAVITY! Rather, install the networks on the same mounting plane as the midbass, toward the passenger compartment, and behind the OEM door panel/skin, so as to not expose the delicate electronic parts contained within to moisture inside the door cavity.

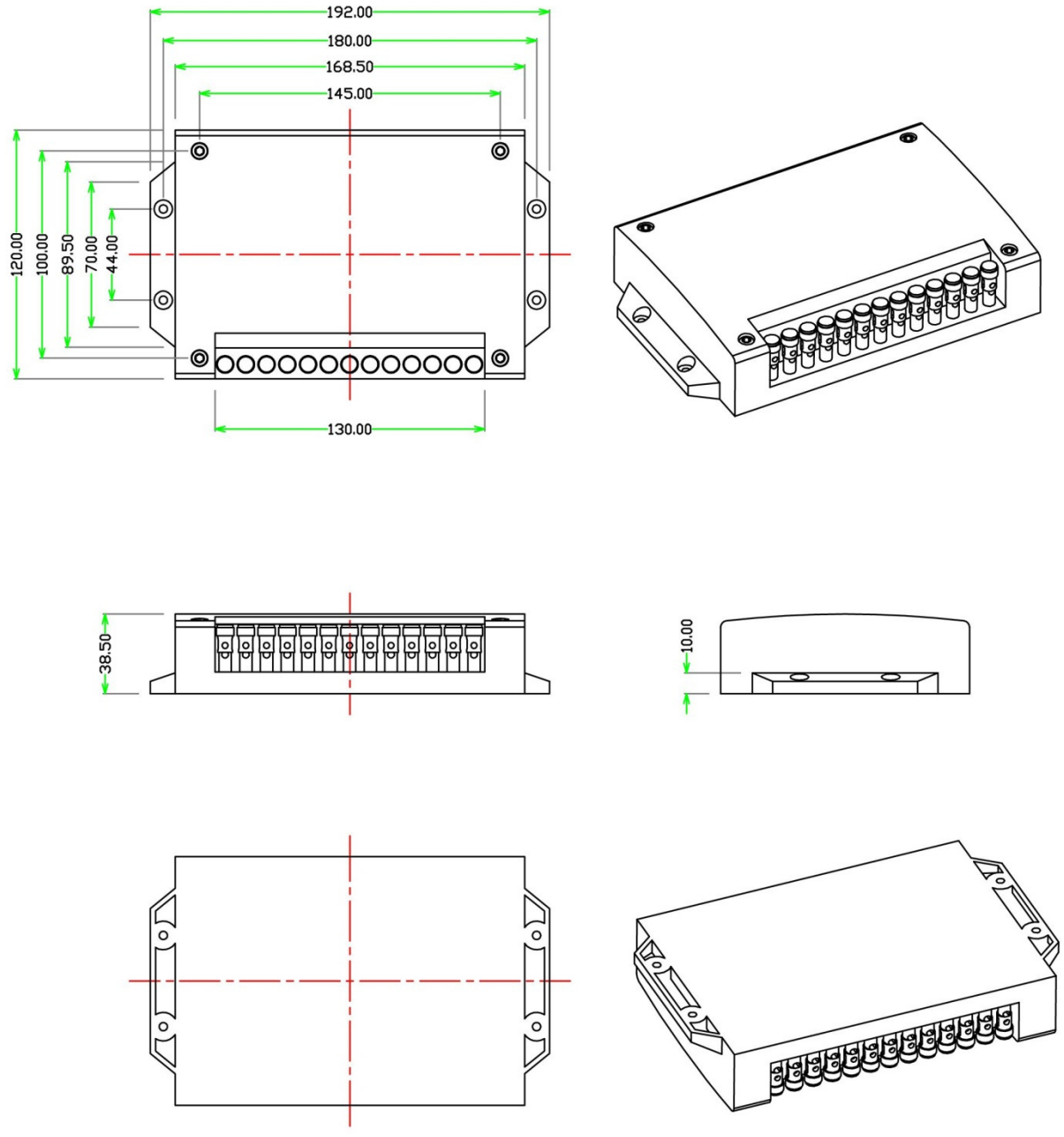
Once an adequate spot for mounting the L3x is found, securely mount the crossover networks using the supplied screws. Before any cutting, drilling, or insertion of screws, check the clearance of the

panel from behind to verify that you won't be damaging existing wiring, window or door lock motors, window tracks and the windows themselves, and etc.

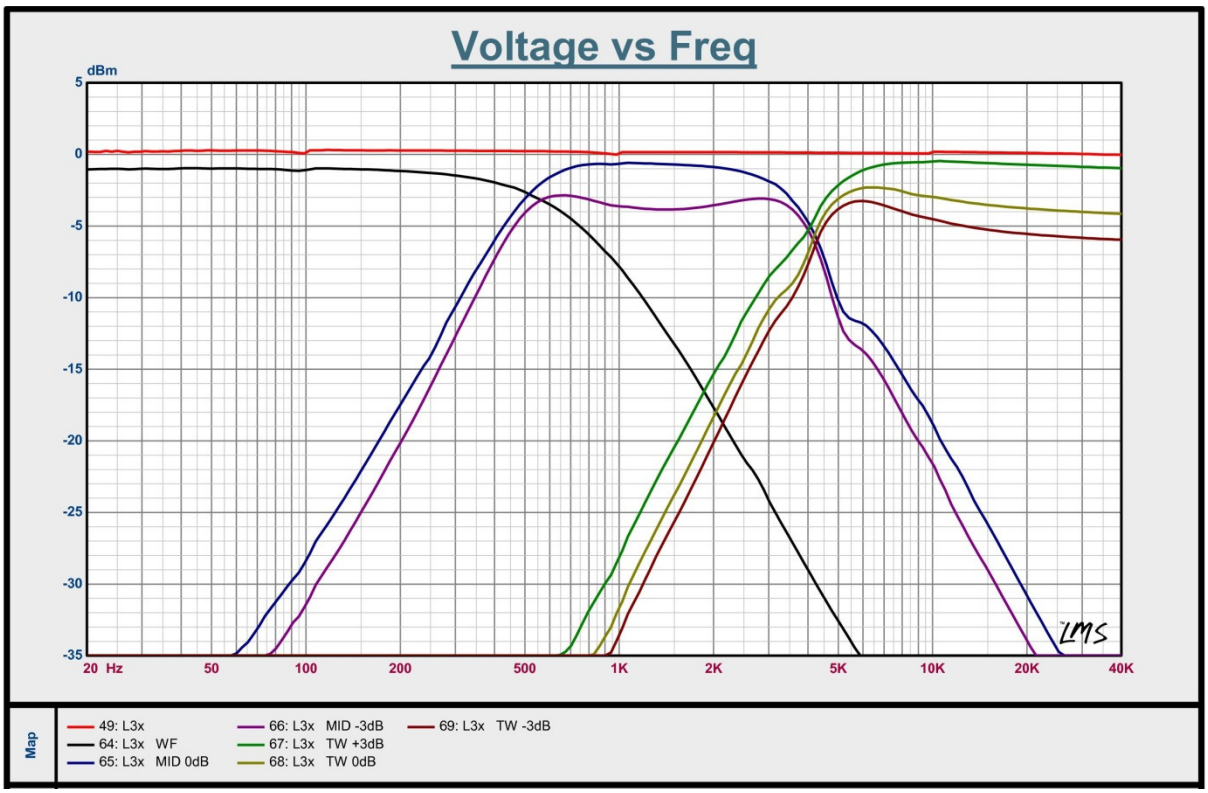
Summary

The Legatia L3x is an exceptional-quality three-way passive crossover device that can be used with any Hybrid Audio speaker system to accommodate any number of different bespoke system designs. At home in virtually any arrangement, the L3x is Hybrid Audio Stage V high-end three-way passive crossover, boasting exceptional performance and a design philosophy that goes hand in hand with true high-fidelity playback.

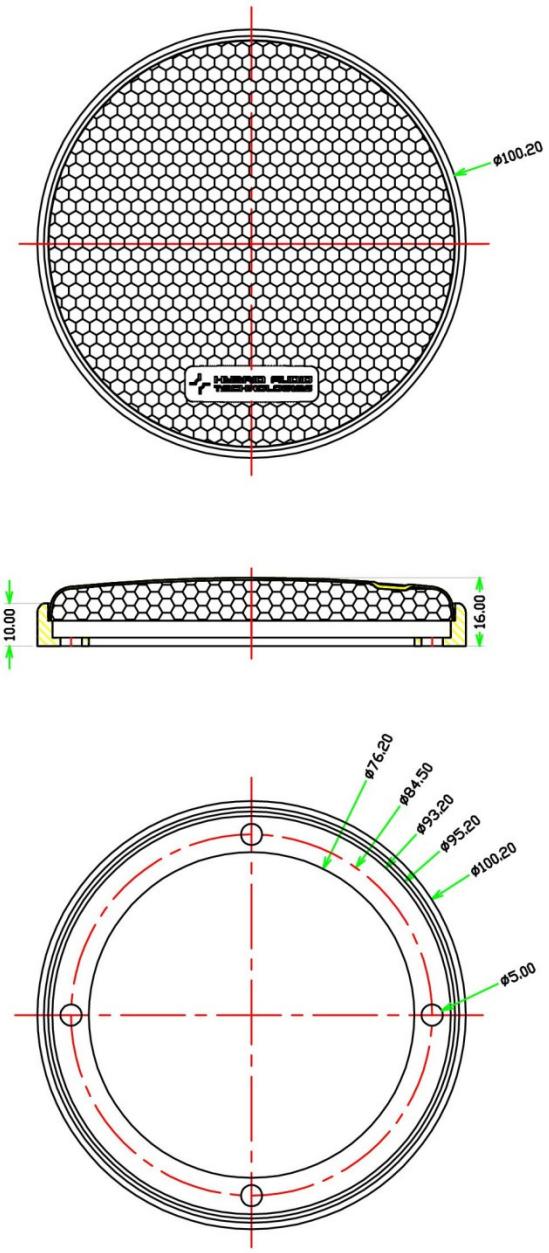
Mechanical Drawing



Frequency Filter Plot



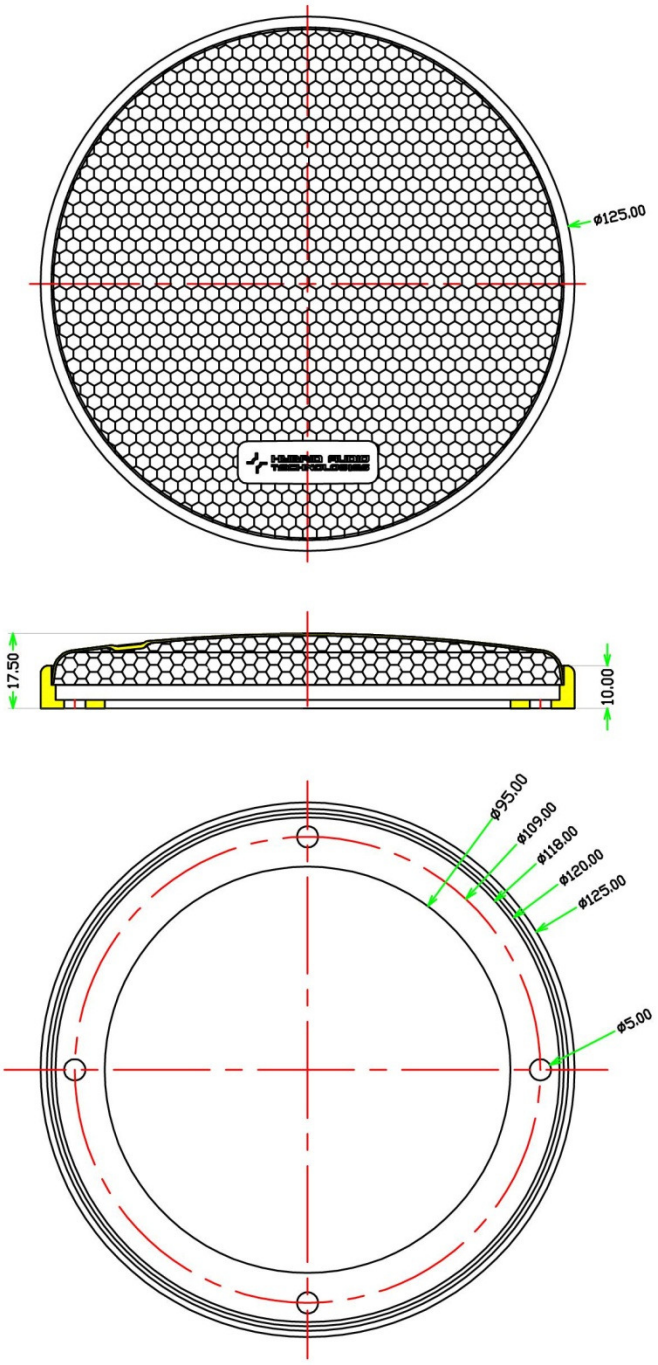
Legatia L3G Grille Assembly



The Legatia L3G grille has application for the Legatia L3V2, Legatia L3SE, as well as the original Legatia L3 offering.

NOTE: The grille height clearance is very close to the height of the phase plug extended pole piece on certain Hybrid Audio models. For this reason, the end-user MUST use the supplied non-hardening gasket material between the plastic retainer and the grille mesh to keep the grille mesh firmly in place, and to allow enough height clearance to the phase plug extended pole piece.

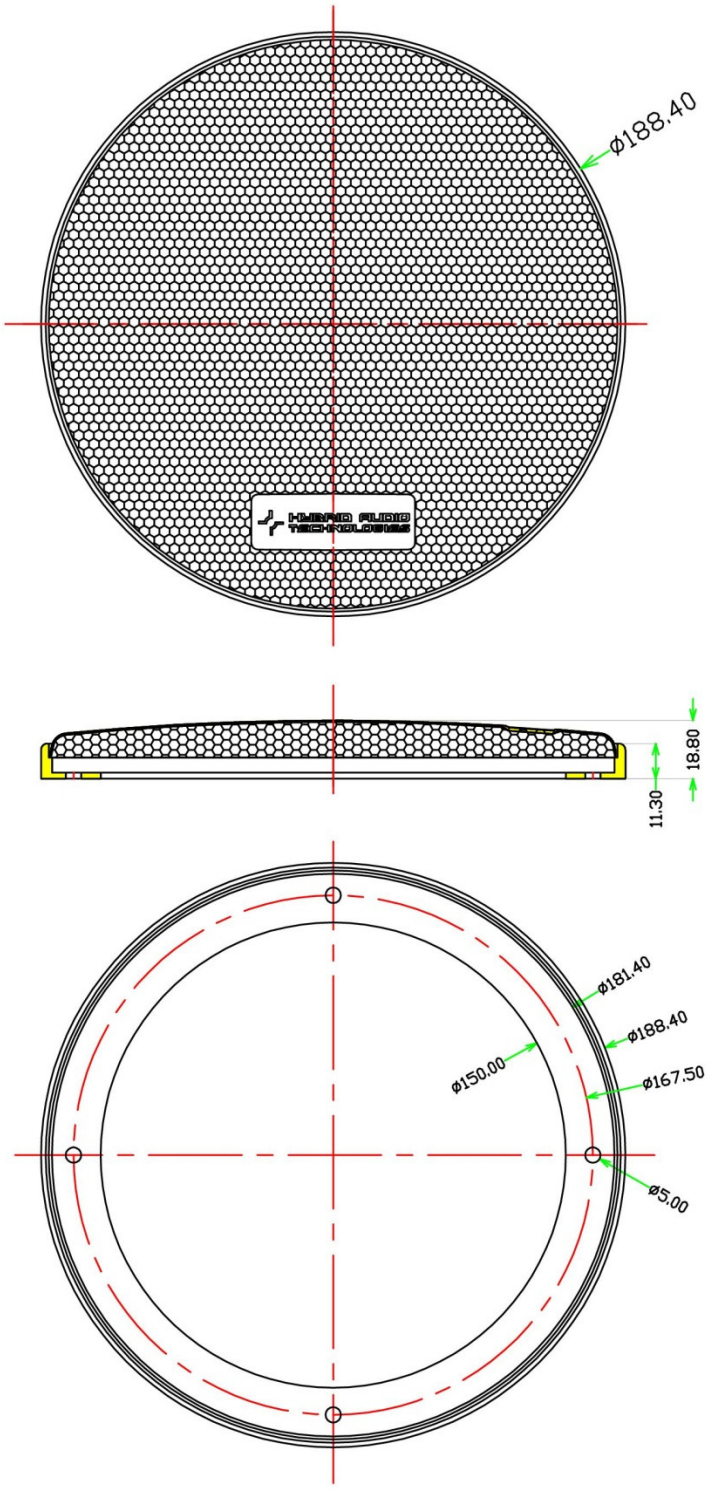
Legatia L4G Grille Assembly



The Legatia L4G grille has application for the Legatia L4, Legatia L4SE, as well as the Legatia L4SE Carbon.

NOTE: The grille height clearance is very close to the height of the phase plug extended pole piece on certain Hybrid Audio models. For this reason, the end-user MUST use the supplied non-hardening gasket material between the plastic retainer and the grille mesh to keep the grille mesh firmly in place, and to allow enough height clearance to the phase plug extended pole piece.

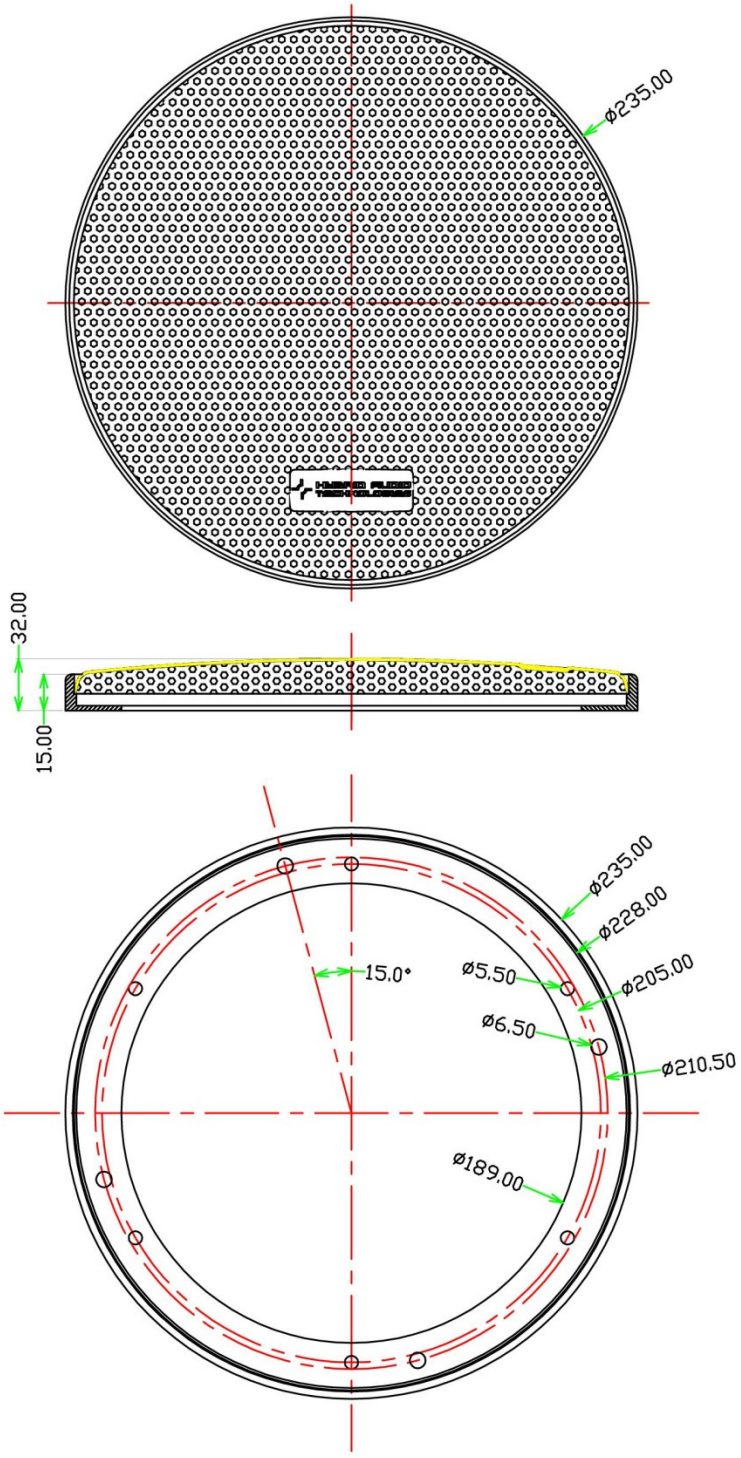
Legatia L6G Grille Assembly



Note: The Legatia L6G grille has application for the Legatia L6V2, Legatia L6SE, as well as the original Legatia L6 offering.

NOTE: The grille height clearance is very close to the height of the phase plug extended pole piece on certain Hybrid Audio models. For this reason, the end-user MUST use the supplied non-hardening gasket material between the plastic retainer and the grille mesh to keep the grille mesh firmly in place, and to allow enough height clearance to the phase plug extended pole piece.

Legatia L8G Grille Assembly



Note: The Legatia L8G grille has application for the Legatia L8V2, Legatia L8SE, as well as the original Legatia L8 offering.

NOTE: The grille height clearance is very close to the height of the phase plug extended pole piece on certain Hybrid Audio models. For this reason, the end-user MUST use the supplied non-hardening gasket material between the plastic retainer and the grille mesh to keep the grille mesh firmly in place, and to allow enough height clearance to the phase plug extended pole piece.

Advanced System Installation

Hybrid Audio Technologies has prepared a more advanced topical discussion of Legatia SE installation techniques, concepts, and principals, where a little bit of additional installation work can net immense gains in overall sound quality.

There are certainly many things you can do to improve your mobile audio system, such as addition of amplification, a dedicated subwoofer system, higher-gauge speaker wire, and higher-end passive crossovers, and active crossovers. All of these things require an additional amount of monetary investment into your audio system, and may not net the immediate gains that other, more elementary installation items can net. The following discussion is pertinent to easy and cost-effective enhancements you can do for your audio system, particularly as it relates to the installation of Legatia SE component speakers.

In any mobile audio system, the weakest link will always be the speaker systems, followed closely by installation techniques (sometimes its vice-versa). Since the Legatia SE component system you have purchased has solved the first issue, the second issue, that being installation techniques, can see a significant improvement as well by understanding and incorporating some or all of the techniques in the following sections.

Lessons Learned

We like to call this our “Lessons Learned” section, where we expose some critical lessons that we have learned through thousands upon thousands of hours of trial and error:

Lesson One: Off-Axis Response

When a speaker system like the Legatia SE is placed in an automotive environment, we hear the direct (shortest path) and reflected (longer path) sounds, such as resonances and reverberations. The two sounds are processed by the brain as one sound, and this influences our perception of height, width, and depth of soundstage, as well as rearward ambience. For this reason, the off-axis radiation pattern of any speaker in a vehicular environment has a significant influence on how natural the music sounds.

The lesson to learn here is that most mobile audio sound systems benefit greatly from having the front stage speakers at least partially “off-axis.” Off-axis means that the speakers are not pointing at you, but rather at some angle less than 90 degrees away from you.

Lesson Two: Equalization of Pathlength Differences

Quite possibly the most important functional consideration that a do-it-yourself enthusiast or professional installer should give to the Legatia SE speaker placement is to optimize, as best as possible, pathlength differences (PLD’s) in the vehicle. PLD’s are defined mathematically as follows (this example assumes a right-hand drive vehicle---PLD’s are always a positive number):

$$X - Y = Z$$

Where:

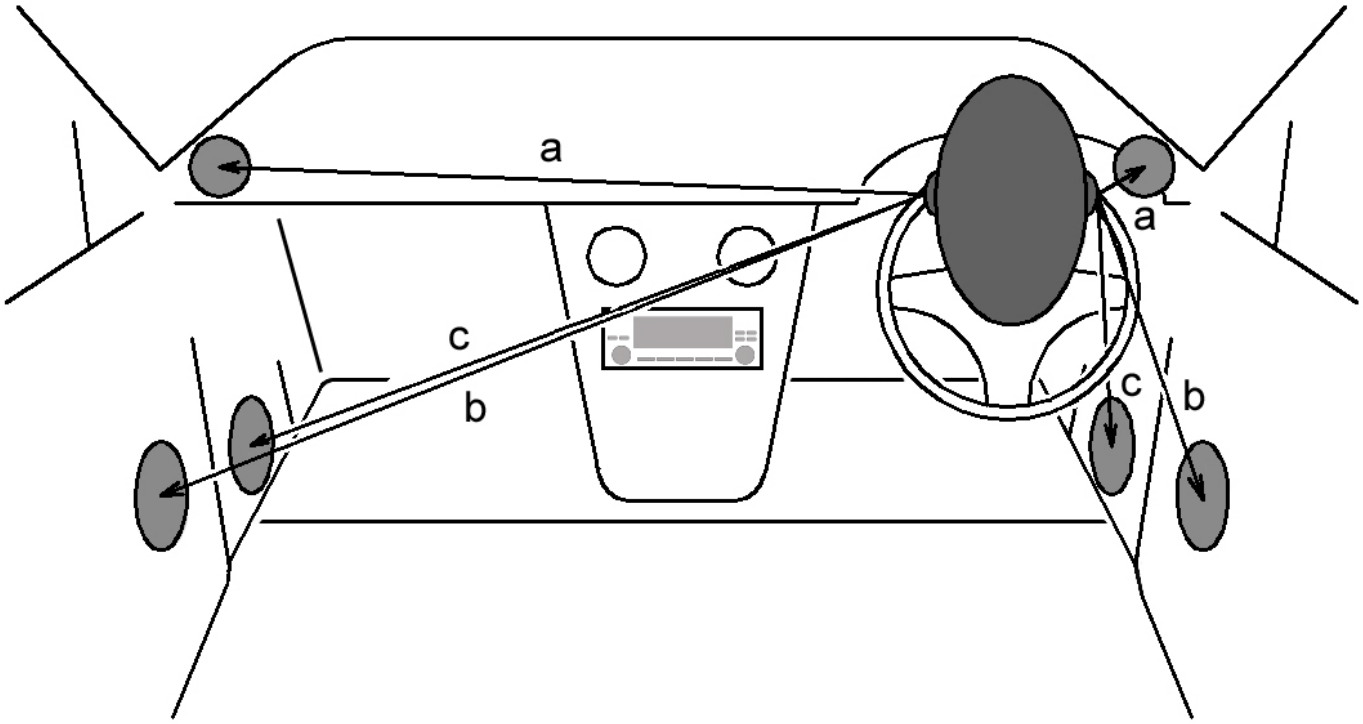
X = distance of the center of the left speaker from your left ear.
Y = distance of the center of the right speaker from your right ear.
Z = pathlength difference.

Applying this formula, assume that the distance of the left speaker from your left ear is 140cm, and the distance of the right speaker from your right ear is 100cm, the pathlength difference is 40cm.

Good stereo imaging is completely dependent on arrival times of the fundamental vocal frequencies. Differences as little as 10 *micro*seconds can be detected by the brain. A PLD of 30 centimeters equates to the sound from the nearest channel arriving about 0.9 *milli*seconds earlier than the furthest channel. It is Hybrid Audio's opinion that the end-user should try to keep PLD's to less than 30 centimeters in a vehicle which is intended to have good imaging and staging character **from both seated positions**.

The best way to go about evaluating certain locations in your vehicle is, in general, to look for the potential locations as far forward and away from you as possible, but still with a general "line of sight" to the speakers (particularly the speaker on the far side of the vehicle). An easy way to test various potential locations is to hold a tape measure or other measurement device from the potential speaker mounting locations, and measure those locations with respect to your ears.

Reference the figure, below. In this scenario, three potential locations for the mounting of the Legatia SE midbass driver are shown:



In scenario “a”, we show the installation of the Legatia SE midbass in the dashboard, high in a door panel, or in the dashboard. As you can see from the diagram, the PLD’s between the left and right speakers are large, due to the proximity of the listener to the near-side speaker. While the mounting of primary drivers in the dashboard or a-pillars has become increasingly popular, this configuration will undoubtedly require both time and intensity domain equalization in most vehicles to ensure a good, focused center image, properly located in the center of the vehicle for **one seated position**. There are, however, some rare exceptions, and you may actually find that the dashboard locations provide the best equalized PLD of the available mounting locations; this is very rare though – in our experience, less than one percent of vehicles on the market today have optimized dashboard speaker locations for the midbass drivers.

In scenario “b”, a typical door installation location is shown, and in many vehicles represents a good improvement in PLD’s from the dashboard, high in the door panel, and a-pillar location identified in scenario “a.” The door speaker installation scenario is the one detailed in the basic installation section at the beginning of this manual, and in most vehicles represents a satisfactory location to mount speakers; not ideal but satisfactory. The door speaker installation scenario will likely also require some amount of time and intensity equalization to ensure a centered image in most vehicles; this can be as simple as adjusting the balance control on your source unit, to more advanced ways of digital time and intensity manipulation.

The third and final potential mounting location as shown in this diagram (scenario “c”) represents a kick panel installation, where the midbass are placed far forward in the A-frame cavity of the kick panels, present in most vehicles. The kick panels are the small panel next to the throttle and brake pedals, down by your feet. While it is not immediately obvious looking at a two-dimensional drawing, in many cases the kick panel location affords the best equalization of pathlength differences for most vehicles. And the reason why this is a good choice for most vehicles is defined in the second full paragraph of Lesson Three, below.

The lesson to be learned here is that by taking a few moments to evaluate the potential mounting locations in your vehicle, in a very short period of time, you will be able to find the best location for your Legatia SE midbass by determining the location with the smallest PLD.

Lesson Three: The Effect of HRTF, ITD, and IID

Head-related transfer function (HRTF), interaural intensity differences (IID), and interaural time delay (ITD) all play a key role in the optimum placement location for the Legatia SE component speakers. A sound wave approaching the eardrum from your chosen speaker location is shaped by interactions with the size and shape of your head, torso, and outer ear, resulting in the HRTF. More specifically, the HRTF is the ratio between the sound pressures of the wave at the eardrum, as compared to the sound pressure that would exist at the center of the head if the head were removed. In general, the sound arriving at the ear further from the source is attenuated and delayed relative to the sound arriving at the ear closer to the source. This generates an interaural intensity difference (IID) and an interaural time delay (ITD). As a sound approaches the head, the ratio of distances from the speaker location to the near and far ears increases, and the effects of head-shadowing are amplified, causing the IID to increase. The spectral shaping caused by the head and the shape of the outer ear may also change. The ITD, which results from the absolute difference in path length from the source to the ears, remains approximately constant as distance decreases. From this we learn:

- ITD is the dominant factor for frequencies below about 500 Hz;

- A combination of ITD and IID are dominant for frequencies between approximately 500 Hz and 2,000 Hz; and
- IID, in concert with HRTF, are dominant above about 2,000 Hz.

These are generalizations, and are subject to the size and shape of one's head and torso, and size and shape of the outer ear (the folds and ridges of the ear), but in general, the above is a good guideline for establishing ITD, IID and HRTF thresholds for the human auditory system.

Because the Legatia SE midbass' ability to play into the sub-200 Hz range, an effect clearly dominated by ITD, up to and including frequencies exceeding 6,000 Hz, an effect clearly dominated by IID and HRTF, placement of this driver is extremely important. The driver should be placed as far forward as possible in the vehicle to optimize ITD. Lateral (forward to back) placement is much more important than horizontal placement (up and down). This is because of the brain's ability to process sounds such as spectral envelope cues, and use a phenomenon known as the "precedence effect"; the brain can be easily "fooled" into thinking a sound stage is high with kick panel or floor-mounted speakers (a word to the wise: the best place to put a set of speakers is not always "up high", as most vehicles do not offer an amicable location in the dashboard or a-pillars for good image placement for both seated passengers, especially in the critical frequencies sub-500 Hz). In addition to the time equalized placement of the drivers, the end-user must also consider that above approximately 2,000 Hz, intensity plays a key role in good sound staging and imaging. Therefore, the Legatia SE midbass' should be placed in an area where intensity differences can be equalized, either mechanically or electronically, to ensure good imaging and sound staging.

The lesson to be learned is that, like Lesson Two, the Legatia SE midbass should be placed as far forward from your listening position as possible, and every effort should be made to optimize time and intensity domain characteristics of the installation.

Lesson Four: Point-Sourcing

The term "point-sourcing" is often used to describe the technique of having a single pair of speakers in an installation cover the majority of the critical middle band frequencies. In many installation scenarios, the Legatia SE midbass could be considered a point-source speaker driver, because it has the ability to reproduce six octaves of tones. Point-sourcing, if done correctly, can lend itself to a variety of valuable attributes, including precise image definition and stable sound staging character. By applying Lessons 1-3 above, the Legatia SE midbass can be used as a point-source driver to achieve excellent staging and imaging results.

The lesson to be learned here is that the Legatia SE midbass, given its wide-bandwidth design, can faithfully reproduce as much as six octaves of tones, and would make a valuable addition to any sound system as a point-source driver for the spectrum comprising vocal imaging cues.

Lesson Five: Reference

One of the most important things to do before completing your Legatia SE installation is to get a reference for your future listening tests. To really know what a snare drum sounds like, you must go and listen to one, in person, live and un-amplified. There is no substitute for the visceral impact and emotion of live music. Nothing else in life can touch your soul the way music does. Whether it's a

200-member orchestra, or a four-piece fusion band, nothing compares to the phenomenon of live music.

Take this as Hybrid Audio's official request: become a student of music and your mobile audio sound system will be better for it. We want nothing more than to know there are great sounding audio systems around the world using our products, and you'd make us all very proud if you became a student of music and learned its beauty and passion.

Advanced Installation of the Legatia SE Component Systems

Mounting Baffle Considerations

Now that we have revealed five of our most important "Lessons Learned", we can now apply these lessons to the Legatia SE installation. The first important matter is the physical installation of your Legatia SE midbass and/or midrange, and more specifically with respect to improving the Legatia SE midbass' or midrange's mounting baffles. Most vehicles' factory mounting locations for speakers are less than ideal. In most cases, the OEM speaker mounting flanges are likely nothing more than flimsy extruded plastic, and provide no sonic benefit to your Legatia SE installation. The Legatia SE drivers are long-throw midbass, and high-performance midrange, and the plastic mounting baffles that come from the factory in virtually every vehicle will lead to buzzes, rattles, vibrations, and resonances, all of which negatively affect the Legatia SE installation. In other vehicles, you may have attached the Legatia SE midbass' or midrange's directly to the door metal (hopefully with a layer or two of self-adhesive sound damping in between), but this is still not entirely ideal. In whatever scenario you have installed your Legatia SE midbass and/or midrange, there are certain "tricks" and techniques that may be applied to get the most out of your Legatia SE component set, specifically the midbass and midrange installation, as follows:

Mounting the baffle, sound damping, and "decoupling": the mounting baffle or mounting location should either be secured extremely well to the vehicle's body, or completely isolated from the vehicle's chassis. The reasoning is that the speaker baffle panel will vibrate and will radiate sound. Even small vibrations can result in the baffle itself radiating more sound than the actual speaker at certain frequencies. The mounting baffle or mounting location should be damped with a layer of typical sound damping to reduce the Q of the baffle and lower its vibration resonance frequency below the range of the driver's frequency response. In many cases, using thicker baffle panel in concert with self-adhesive sound damping can also be advantageous, provided the rearward wave of the speaker has no obstructions created by the baffle itself. Finally, if possible, the speaker should be mechanically decoupled from the baffle. This can be something as simple as a layer of self-adhesive foam tape, to more exotic examples of decoupling, including rubberized rings or multiple-layer septum shielding.

Building solid mounting baffles: in many cases, it is advisable to mount your Legatia SE midbass' and/or midrange's in high-stiffness wood or high-density fiberglass (or wood treated with fiberglass resin). Hybrid Audio Technologies recommends the use of a solid hardwood, such as birch or oak, namely because these woods are stiff and help to dissipate resonance, and screws can be inserted and removed multiple times without stripping. Avoid Medium Density Fiberboard (MDF), particularly in wet environments like the door, as the MDF will act like a sponge with humidity and moisture, and not only that, the MDF is a dense, but not stiff type of wood, and the results may not be particularly noticeable if you use MDF. Once your baffle is built, it must be covered in one or two layers of a

good-quality, brand name self-adhesive damping product; a solid wood mounting baffle with sound damping treatment will augment the Legatia SE installation by eliminating resonances.

Mounting baffle dimensions: While building baffles is important, it is notable that mounting baffle size is equally important. All mounting baffles should be kept as small as possible with respect to the size of the speaker. The purpose of using a small baffle is to avoid the potential for low amplitude diffracted sound waves becoming summed with the incidental waves. A narrower baffle also becomes increasingly important as frequencies range into the Legatia SE midbass' and/or midrange's upper bandwidth, where the power response is more uniform and incident and reflected waves are indistinguishable. In practical terms, keep baffle dimensions small with respect to the size of the Legatia SE midbass and/or midrange, chamfer or round sharp edges (including, in particular, the mounting hole's rear inner edge), flush-mount the speaker whenever possible, and use shallow, surface-mounted hardware. Also, remove all unnecessary protrusions from the baffle surface.

Crossovers

One of the most fundamental and important considerations in the final tweaking of a car audio system is the set-up of the speaker's crossovers. The Legatia SE drivers use rigid paper cones that exhibits little if any cone breakup in its upper frequency bandwidth. However, it is still important to utilize crossovers, especially active crossover networks to suit the speaker system to the car's acoustic signature. It has been Hybrid Audio's philosophy to tune the speaker system to the vehicle's acoustic signature using just active crossovers, and only a very minor amount of equalization. Our very best world championship vehicles have always had one thing in common: creative use of active crossover filters and very minimal equalization. Use your crossovers to tune your car, and the equalizer to suit the vehicle's speaker response to your own tastes.

The first thing to remember is that every speaker exhibits some sort of a natural roll-off. This rolloff typically amounts to about 12 dB/octave, and needs to be taken into account, especially when designing passive crossover systems (this roll-off has been accounted for in the Legatia SE L2x and L3x designs). Simply adding a capacitor and inductor in series (6 dB/octave bandpass filter) to a Legatia SE midrange driver does not necessarily mean that you'll see a phase coherent 6 dB/octave bandpass filter at its crosspoints. In fact, summing the effect of the driver's natural bandpass roll-off, you might actually be approaching a theoretical 18 dB/octave bandpass filter at certain frequencies. Not only this, but the speaker could potentially begin to exhibit significant intermodulation distortion as the cone becomes non-linear trying to reproduce the lowest octave of tones, not to mention irregular polar radiation patterns between the Legatia SE midbass/midrange and the accompanying Legatia SE tweeter.

Given the large uncertainty of low-order crossover systems, Hybrid Audio recommends the use of higher-order electronic crossovers so that fine tuning can be done electronically. The active network benefits from easy correction of different speaker sensitivities and equalizing not only the individual drivers but the combined response as well. Not having to account for the speaker's impedance verses frequency, as well as the passive device impedance and phase shift makes the active filter superior to most passive crossover networks, due to the fact that each and every aspect can be tailored to better suit the individual installation's requirements. However, we understand that in some cases that passive filters are required, and thus the reason why we have manufactured the Legatia L2x two-way and Legatia L3x three-way passive crossover systems. In our humble opinion, however, the ideal crossover system for most users, is an active one that takes into account the Legatia SE driver location and its characteristics, in concert with the polar radiation patterns of other speakers

involved, all the while balancing linear and non-linear distortion (non-linear harmonic distortion increases with sound pressure level or cone displacement, and thus, crossover frequency is critical and can be vehicle and user dependent).

As mentioned previously in “Lesson Three”, imaging cues of near-field (within 3m) sources come from effectively two auditory methods: ITD and IID. ITD is the time it takes for sound to reach the far ear after reaching the near ear. Typical adult male heads have an ITD maximum of approximately 400 microseconds. IID is the measure of intensity difference of the far ear as compared to the near ear. ITD is typically used by the brain to localize low frequency sources below 500 Hz. IID is typically used by the brain to localize high frequency sources, above 2,000 Hz. HRTF is also used in conjunction with IID. Above approximately 4,000 Hz, the higher frequencies are attenuated by the head for the far side ear. A sound to your left will have a different spectral content for the left ear as compared to the right ear. The HRTF is unique for each individual (based upon shape and size of the head and torso) but typically occurs at around 4,000-5,000 Hz. HRTF will affect the IID at even higher frequencies, more so than simple average SPL. Above 6,000 Hz or so, the HRTF portion of IID becomes the dominant factor. The spoken word (human voice) comprises a fundamental frequency range of approximately 150 Hz to 6,000 Hz.

Taking the above into account, your desired crossover frequency for the Legatia SE midrange and/or midbass should be one that allows the midbass or midrange to play as much of the audible spectrum of the spoken voice to ensure point-source delivery of the tones and pinpoint image definition. In many cases, this would be around 200-250 Hz for high pass, and around 6,000 Hz, or higher, for low pass. In all cases, the chosen crossover frequencies should be evaluated for sonic character, while balancing distortion and power compression at high amplitude levels.

Time Correction

It is our humble opinion that time correction should only be used in three different circumstances:

1) When the installer recognizes that a vehicle cannot image properly from both seated positions and it seems more plausible to make the vehicle stage and image well from only one seated position.
2) To counter the effects of group delay.
3) Time alignment between pairs of drivers.

Scenario 1

The first scenario is rather elementary. If a vehicle is too small to achieve equalized PLD’s, it doesn’t lend itself well to equalized PLD’s, or the vehicle’s owner doesn’t wish to embark on physical reconstruction of the car to achieve optimized PLD’s, it is a good use of time correction to make the vehicle image well from the single seated position. It should be noted that it is Hybrid Audio’s opinion that it is always better to improve the car mechanically and attempt to fix mechanical problems with mechanical solutions, than it is use to electronics to fix mechanical problems. However, we realize that there is the occasion when there is little desire to try to mechanically optimize one’s listening space, and electronic manipulation is desired. It is important to recognize that, given the fundamentals of ITD and IID discussed previously, time alignment is rendered virtually useless for frequencies above approximately 2,000 Hz.

Scenario 2

In the second scenario, the use of time correction is much more cognitive, and shows great promise for countering the effects of group delay. Group delay is impulse response over time. Group delay increases significantly at low frequencies, and is considerable in larger midbass and subwoofers. An excellent use of time correction would be to delay the smaller Legatia SE midranges and tweeters with respect to the larger midbass and subwoofers, so that the low frequency delay of these drivers is synchronized in the time domain with the output of the midrange and treble frequencies.

Scenario 3

The final scenario is time alignment between pairs of drivers. When employing multiple drivers in order to achieve a unified listening experience within a vehicle, it's usually a requirement to install the drivers at physically separated locations; for example, your midbass may be located in the doors, and the midrange and tweeter may be located in the dashboard or a-pillar. In order to compensate for this, you might choose to selectively delay certain speakers in the installation so that all of the tones reach your ears at the same time (note that as previously alluded to, time alignment of your tweeters would be rendered virtually useless).

Amplitude Equalization

An excellent use of today's dual-mono equalizers and advanced digital signal processing is the ability to equalize amplitude anomalies between speakers and sets of speakers installed in a vehicle. In a vehicular installation, the frequency response of drivers can sometimes be manipulated for the betterment of the system using independent left and right amplitude adjustment. Virtually any good car audio system can be made better with judicious use of a minor amount of equalization. And while equalization will not cure phasing anomalies in a car, usually the product of vehicular mechanics, they can certainly be helpful in fine-tuning the system to your own personal taste or in the quest for playback accuracy to the original musical composition.

One important consideration of amplitude equalization (also known in some circles as "amplitude alignment") is the ability to tune those frequencies above about 500 Hz that are not completely affected by time correction. The very best vehicles have some sort of amplitude equalization between the left and right speakers to account for IID and HRTF. After your Legatia SE system is installed, you may wish to attempt some minor amplitude equalization between the left and right channels to achieve a more stable image that is not frequency dependent, or perhaps to improve image placement or stage coherency.

Acoustic Treatment

A considerable benefit can be made to any mobile audio system with the select placement of acoustic treatments. The purpose of using acoustic treatments is to reduce the amount of reflected energy in the hostile automotive environment, and hear more of the direct sound being emanated from the speaker. It is akin to the signal to noise (S/N) ratio in a piece of electronics, where the signal could be considered the direct energy coming from the speaker, and the noise could be considered the reflected waves off of nearby surfaces, such as windows, hard center consoles and door panels, windscreens, and etc. A word of warning though: there is a fine line between too little and too much acoustic treatment; just as some vehicles can benefit from some selectively applied treatments, there is a point where the vehicle can begin to approach "semi-anechoic" conditions, and lose its liveliness,

which is not ideal. Reflections are all around us, and are a part of our day-to-day lives. It is our opinion that some lateral reflection is a good thing; it helps to establish stage boundaries, and gives the recoded playback and more visceral and “believable” sound.

The first principle to understand is that below 200 Hz, acoustic treatments are rendered virtually useless. It is Hybrid Audio’s assertion that only those frequencies above 200 Hz benefit from the use of treatments, given that a 200 Hz waveform is about 1.7 m long; 1.7 meters is less than or equal to most vehicle widths. This is also the frequency where we believe pure tones in the vehicle are going to be difficult, if not impossible to localize. Finally, most vehicles exhibit a Schroeder Frequency (Fs) between 50 at 125 Hz; the Fs (or cabin-gain frequency) is vehicle dependent, and is the frequency at which resonances become so tightly packed in frequency and space that the acoustical properties of the vehicle behave quite uniformly. (As an aside, one significant benefit of car audio sound systems is that frequencies below the lowest room resonance increase at a theoretical 12 dB/octave…it’s no wonder car audio systems have such great bass!)

Acoustic treatment can be very effective above 200 Hz, depending mostly on the polar radiation pattern of the speaker. In the case of the Legatia SE midbass, the polar radiation pattern is quite large at lower frequencies, with a narrowing of the radiation pattern (“beaming”) at frequencies into the treble bandwidth.

Should the Legatia SE midbass and/or midrange be placed in the kick panel locations, one may find that a notable improvement can be made by adding acoustical treatments, such as open-cell foam, into the underside of the dashboard. Likewise, should the midbass, midrange, and/or tweeter be placed up high on a-pillars, or in the dashboard, where comb filtering (reflective summation and cancellation off of a hard surface, such as a windscreen) may become an issue, a dashboard “mat” or other soft furnishing may be a noticeable improvement. It will require trial and error to get it right, but the learning is in the experimentation!

Advanced Installation Conclusions

Sadly, there are no rules in mobile audio, only several hypothesis and theorems that seem to work for most vehicles. Your vehicle may be different, and defy everything we know, and everything written in this manual. You may find that getting that rich, detailed sound that you crave may require some experimentation and a lot of work to make it right. Or you might be fortunate to have a vehicle that sounds excellent with minimal work. Have patience and work through the issues; the result will be a rewarding musical experience in your vehicle! Just remember, it is critical to get a reference, as detailed in Lesson 5. Go out and become a student of music and audio, learn, and improve your audio system one step at a time. The journey is exciting and rewarding!

What we have included above is only a very brief primer to the world of high-end mobile audio systems. We invite you to read more by going to our website.

Warranty

Hybrid Audio Technologies extends a limited one year warranty to the original purchaser, certifying that this product will be free from defects in materials and workmanship under normal and proper use for one year from the date of purchase.

Hybrid Audio Technologies' responsibility under this warranty is limited to replacing or repairing, at Hybrid Audio Technologies' option, products or parts determined by Hybrid Audio Technologies to be defective either in materials, or workmanship. To attain warranty service, the customer must deliver the product or the defective part(s), appropriately packed with proof of purchase date, to an authorized Hybrid Audio Technologies dealer. In the event that a direct return from a consumer is required, the consumer must obtain from Hybrid Audio Technologies a return authorization number, and ship the defective product directly to Hybrid Audio Technologies. All shipping expenses are the customer's responsibility. If the product has been updated or superseded, a replacement will be made with a current model of the same quality and function. Warranty of the replacement parts is limited to 90 days or the unexpired portion of the warranty period of the product on which the parts are being used, whichever is longer.

This warranty does not cover any defects or costs caused by: (1) modification, alteration, repair or service of this product by any persons or company other than Hybrid Audio Technologies; (2) physical abuse to, overload of, or misuse of, the product or operation thereof in a manner inconsistent with the use indicated in the instructions; (3) any use of the product other than that for which it was intended; or (4) shipment of the product to Hybrid Audio Technologies for service. This warranty does not cover labor costs.

Hybrid Audio Technologies is not liable for any special incidental or consequential damages, including, but not limited to, personal injury, property damage, damage to or loss of equipment, loss of profits or revenue, costs of renting or buying replacements and/or any other additional expenses, even if Hybrid Audio Technologies has been informed of the prospect of such damages. Any express warranty not provided herein, and any remedy which other than the warranty contained herein might arise by inference or operation of law, is hereby excluded and disclaimed including the implied warranties of merchantability and of the fitness for a particular purpose.

Thank You!

Hybrid Audio Technologies is delighted that you have chosen a Legatia SE component system for your high-end mobile audio sound system. We are convinced that a great product offering, backed up with unsurpassed customer service and technical support will advance the Hybrid Audio Technologies namesake in the coming years. We are pleased that you have joined us in our “new generation of in-car audio.”

If there is anything we can do to help you get the most out of your Legatia SE installation, please do not hesitate to contact us at info@hybrid-audio.com, or by visiting us at www.hybrid-audio.com!

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